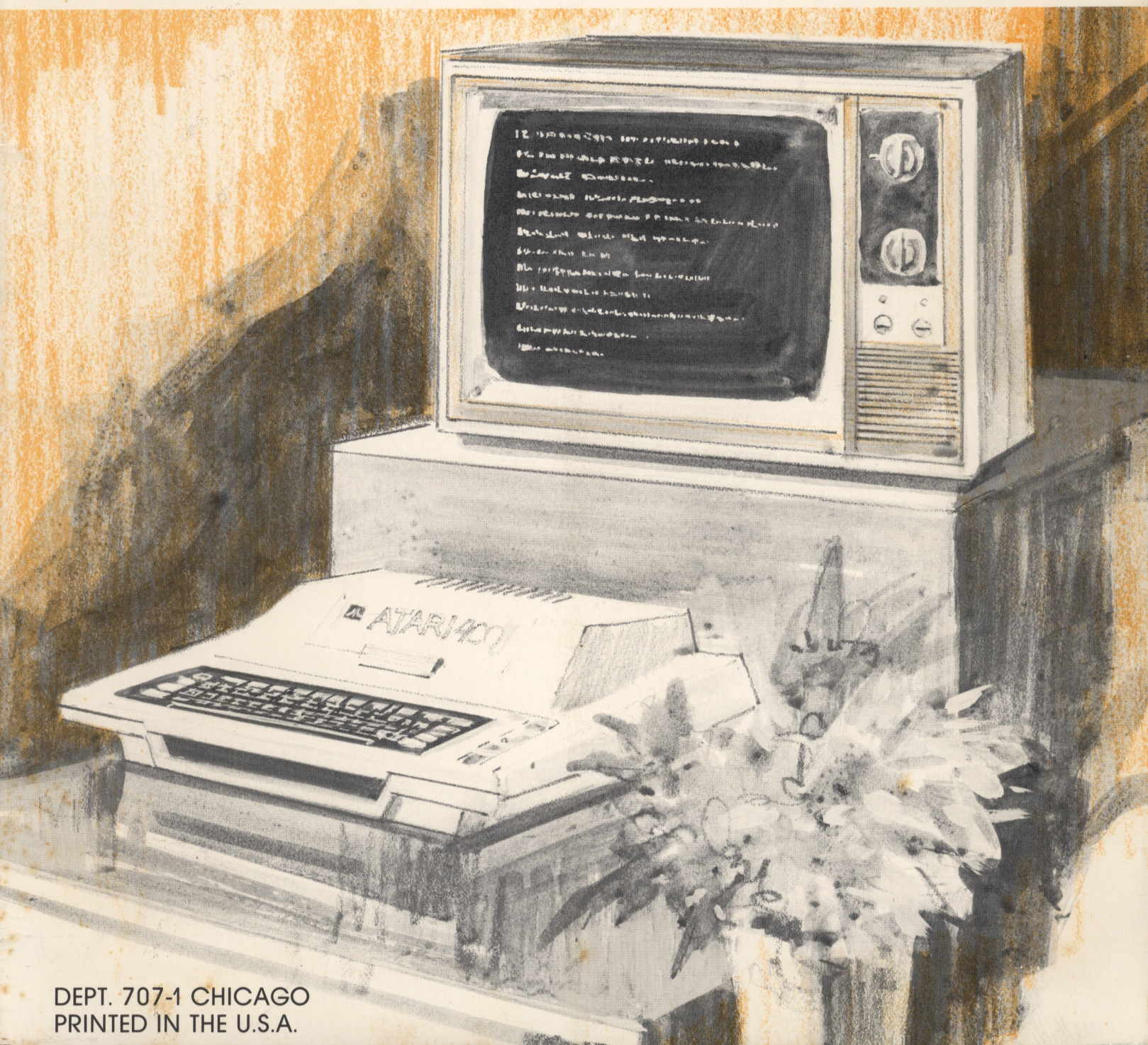
NATIONAL Sears TRAINING

DIV. 3
SOURCE 637 COMPUTERS
ATARI

79-03S-1



DEPT. 707-1 CHICAGO
PRINTED IN THE U.S.A.

ATARI 400

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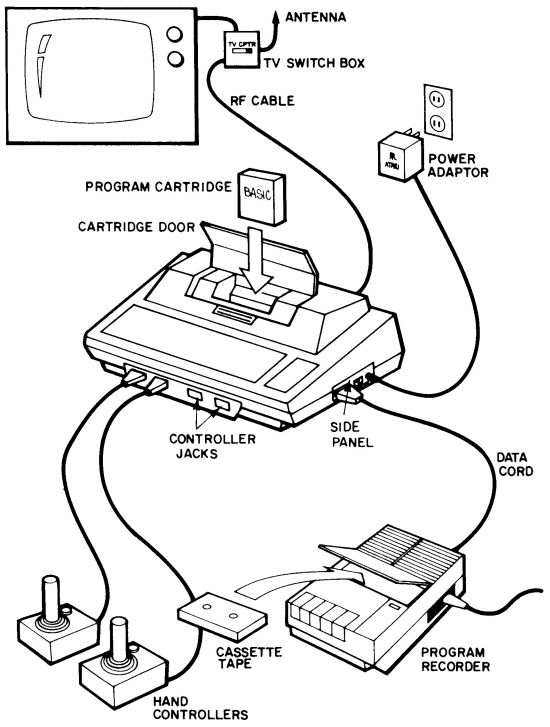
ATARI 400

SYSTEM DESCRIPTION



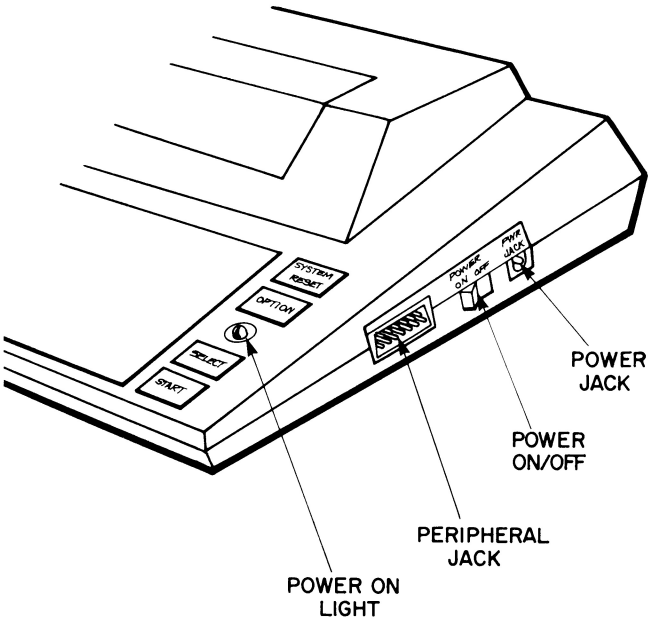
General:

The Atari 400 is a general purpose microcomputer that connects to the users TV and is easily adapted to special applications. Inserting a pre-programmed cartridge adds software to the system to program it for special applications such as playing a chess game. The "BASIC" cartridge allows the user to write and execute his own programs. The optional cassette recorder accepts both pre-recorded cassette tapes and blank tapes used for storing data and programs written by the user.

A wide variety of user-installed options are available:

1. Program Cartridges—Adds capability to play games or special applications like checkbook balancing.
2. Hand Controllers—Three different types of hand held controllers for playing various gamesm
3. Cassette Tapes—Educational tapes with narration and video display for use with the optional cassette recorder.

THE CONSOLE



The Atari 400 console is the central processing unit (CPU) for the system. It comes with a built-in Keyboard, 8K of RAM, and connectors (jacks) for adding peripherals and hand controllers. A 15 foot built-in RF cable provides video and audio signals to the users TV set.

The controller jacks on the front of the console accept any of the three types of hand controllers. The side panel (right hand side) receives all other connections (Figure 2). From left to right they are:

1. Peripheral Jack—Accepts data cord from any peripheral. Multiple peripherals are "Daisy-Chained" to each other.
2. Power On/Off Switch—Turns system power on and off.

   NOTE: Opening the cartridge door also cuts power to the system for cartridge insertion and removal.
3. Power Jack—Accepts the low voltage power cord from the AC power adaptor.

The channel 2/3 switch located on the back of the console switches the console to channel 2 or channel 3 transmission frequency.

KEYBOARD

The Keyboard provides a full alphanumeric character set, cursor controls, and special computer keys. The alphabet keys become special graphic symbols when the "CTRL" (Control) key is held down. To the right of the Keyboard is the power on light and four special control switches. From top to bottom they are:

1. System Reset—Interrupts whatever the computer is doing and restarts from the beginning of a cartridge.
2. Option—To choose among the variations within a game or program.
3. Select—To select one of several games or programs in a cartridge.
4. Start—To start the game or program selected from a cartridge.

"BASIC" CARTRIDGE

This cartridge adds the software to the system to allow the user to write his own programs in "BASIC", an easy to learn programming language. Programs written by the user are stored in the consoles' memory and are erased when power is off. Program to be saved must be transferred to cassette tape so they can be re-loaded when needed.

POWER ADAPTOR

The power adaptor converts the household power (110V AC) to 9V AC for the console.

THE PROGRAM RECORDER (OPTIONAL)

The program recorder (cassette recorder) has two channels, a data channel for video display (TV screen) and an audio channel. Pre-recorded tapes contain an audio track that allows narration and music to accompany the tapes through the TV speaker. Programs recorded by the user onto cassette tape can only record on the data channel. There are six control buttons on the program recorder from left to right they are:

1. Record
2. Rewind
3. Play
4. Advance (Fast Forward)
5. Stop/Eject
6. Tape Counter Reset Button

TV SWITCH BOX

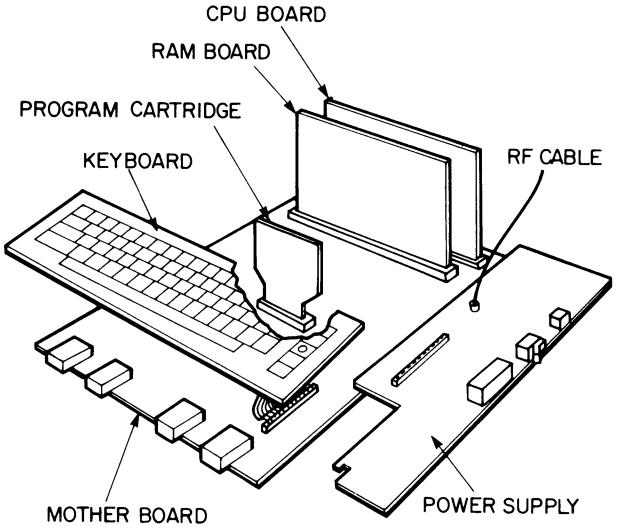
The TV switch box receives the users' external TV antenna and the consoles' R.F. cable. A switch on the box allows the user to select between computer and TV reception.

HAND CONTROLLERS

Each game cartridge is used with one of the three types of hand controllers. These controllers have knobs or a joystick for controlling the game as well as a "fire" button. The games may be played with from one to four controllers.

ATARI 400

THEORY OF OPERATION



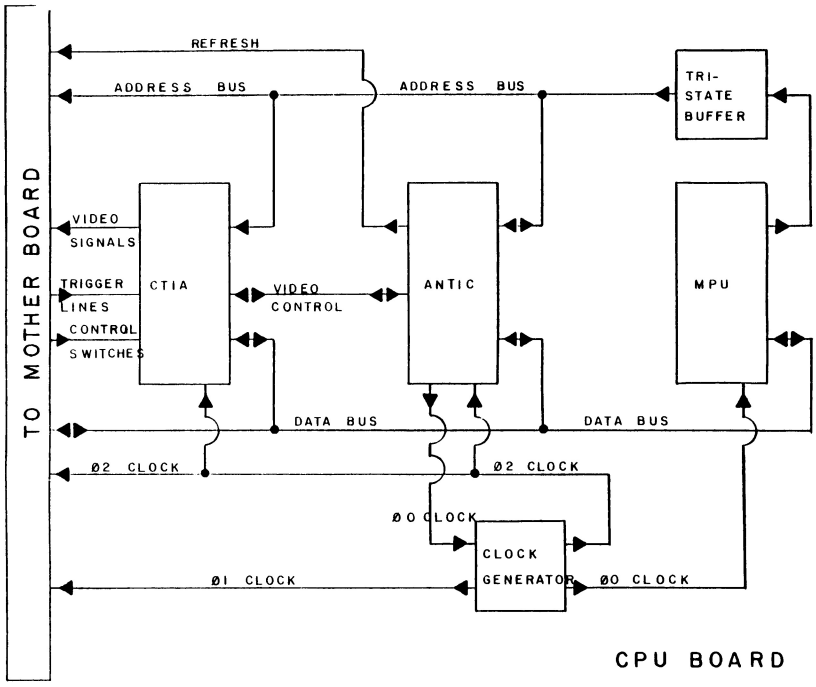
General:

The Atari 400 computer console consists of six basic sections (Figure 3):

1. MOTHER BOARD
2. CPU BOARD
3. RAM BOARD
4. KEYBOARD
5. POWER SUPPLY
6. PROGRAM CARTRIDGES

The logic boards plug into sockets on the MOTHER BOARD with common address, data, power, and clock lines. Power from the POWER SUPPLY is sent to the MOTHER BOARD, which then distributes it to the other printed circuit boards. The KEYBOARD connects directly to the MOTHER BOARD via a ribbon cable. Sixteen address lines allow the microprocessor to access 65,536 (64K) individual memory locations, and eight data lines are used for data communication.

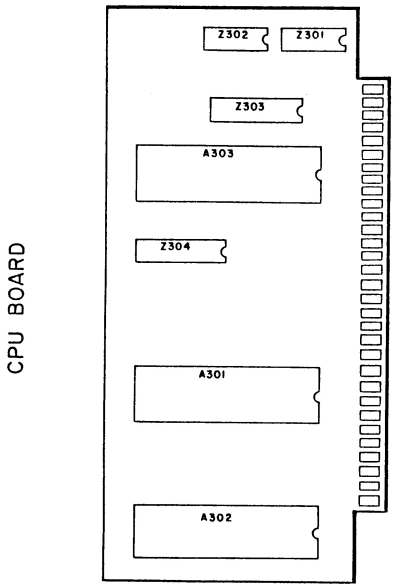
CPU BOARD



CPU BOARD

The CENTRAL PROCESSING UNIT (CPU) BOARD performs the function of controller for the entire system. The heart of the board is a microprocessor that controls the console through address lines (to select which device it needs to communicate with) and data lines (to transmit or receive data from a

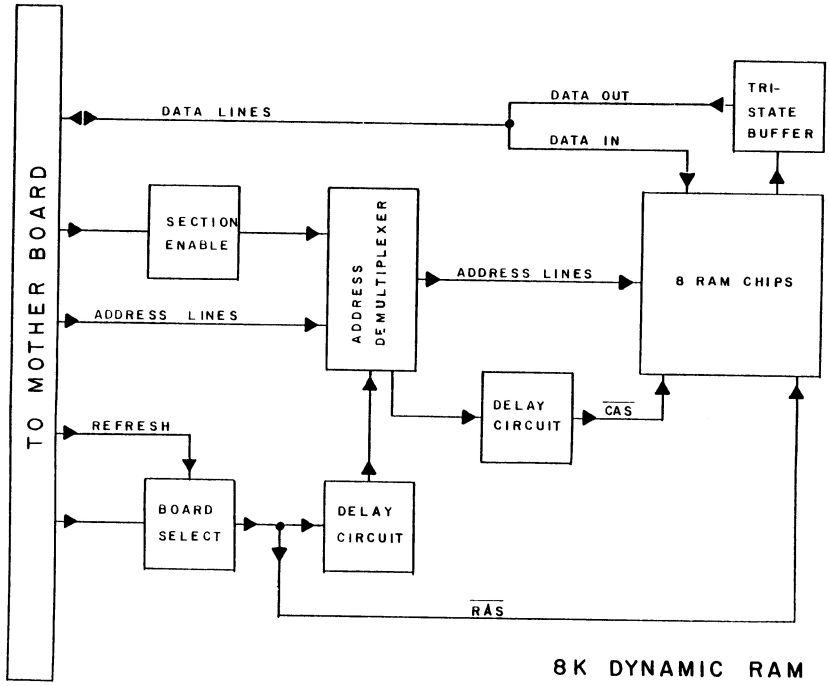
selected device) common to the entire console. Operating instructions for the microprocessor come from the ROM's on the MOTHER BOARD.



Additional Functions:

1. Receives master clock from MOTHER BOARD and generates Phase 1 (01) and Phase 2 (02) clocks used to synchronize the system.
2. Transmits "refresh" signal at least every 2 milliseconds to refresh the dynamic RAM on the RAM BOARD(s).
3. Receives the four "trigger" signals from the fire buttons on the hand controller accessories.
4. Receives the lines from the four control switches to the right of the keyboard:
   - Select — Selects one of several programs in a cartridge.
   - Option — Selects a variation of the selected program.
   - Start — To start a program.
   - System Reset —To reset the system.
5. Generates video signals to be processed by the MOTHER BOARD then sent to the monitor jack and the RF module on the POWER SUPPLY BOARD.

8K RAM BOARD

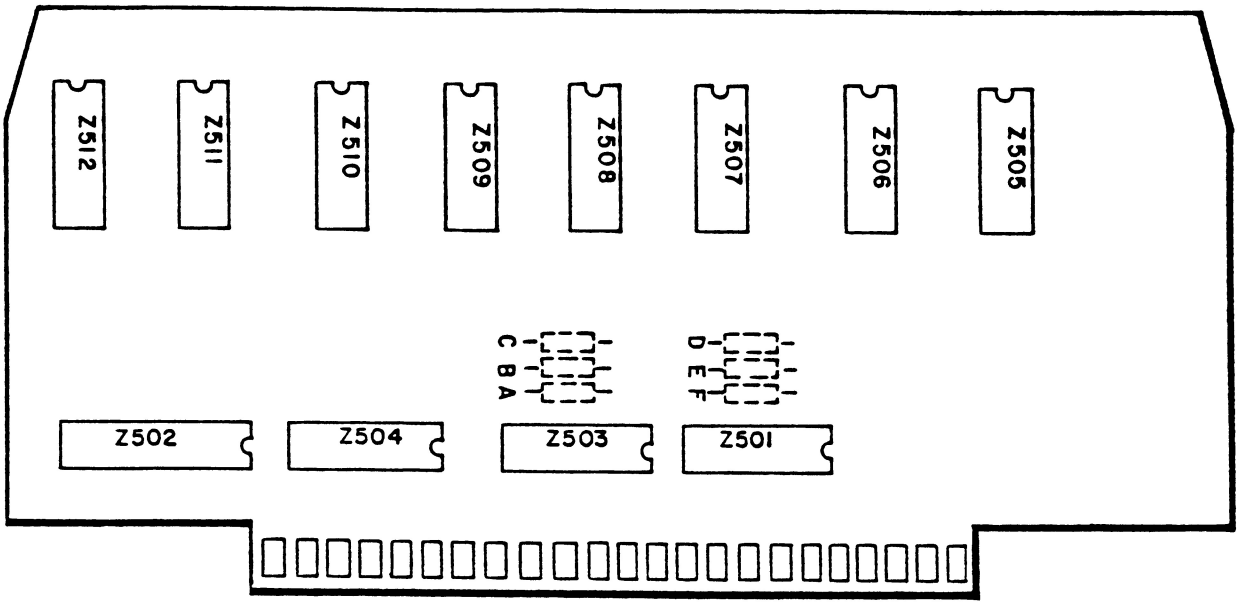


8K DYNAMIC RAM

The 8K RAM BOARD performs the function of temporary data storage for the microprocessor using dynamic RAM.

1. Addressing the RAM:
The RAM chips used have only seven address lines, but to address 8K separate locations would require

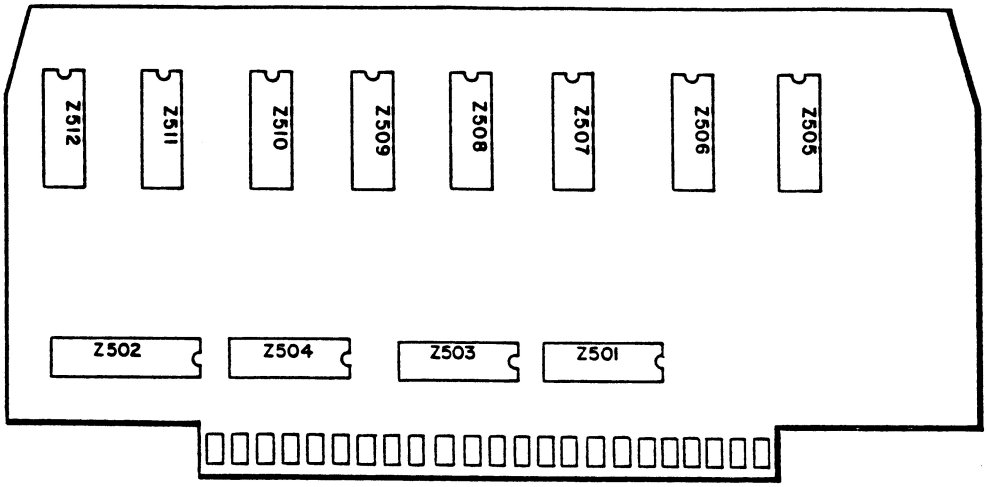
8K RAM BOARD LAYOUT

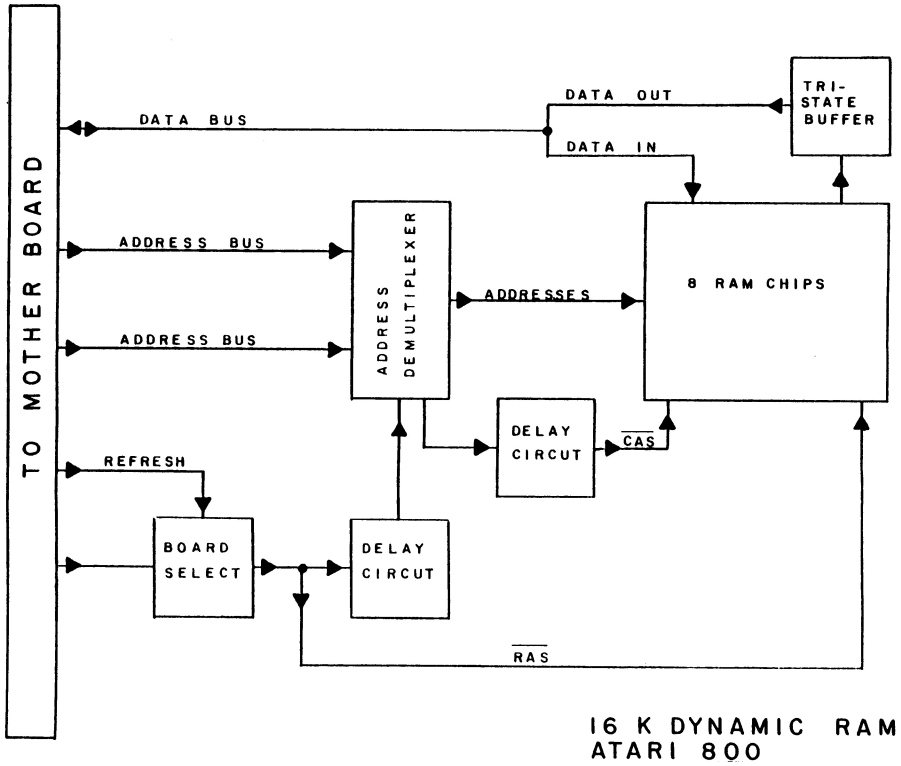


thirteen address bits. To accomplish this, a thirteen bit address is sent to the address demultiplexor which first passes the lower seven bits to the RAM as a row address. After an appropriate delay, the highest six bits are passed as a column address. Data is then either written in or read out of the location selected.

2. Refresh:
Refresh occurs at least every 2 milliseconds from the refresh signals generated by the CPU BOARD.

16K RAM (OPTION)

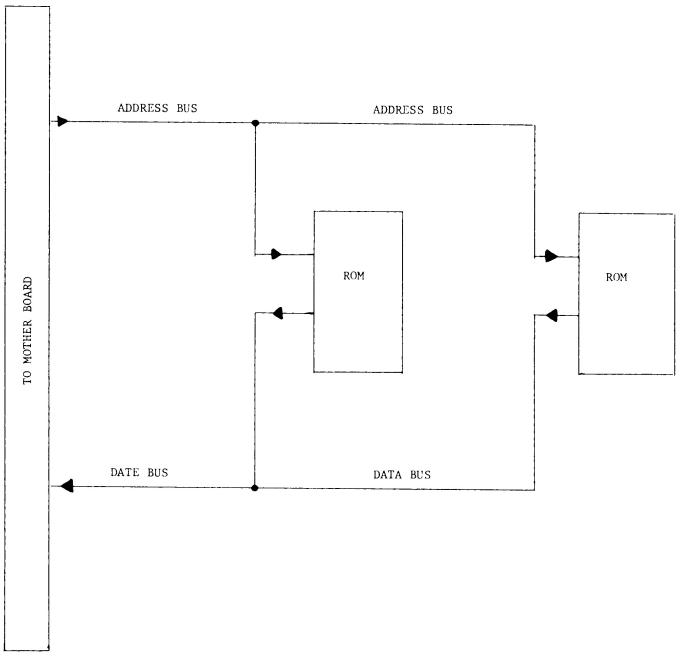




16 K DYNAMIC RAM
ATARI 800

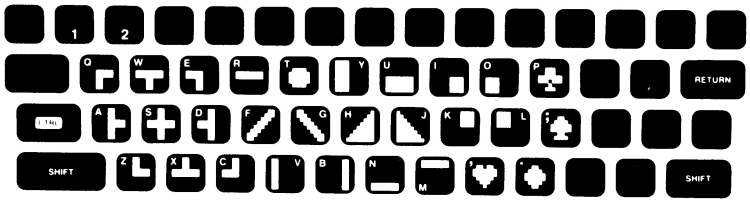
A 16K RAM Board is available as an option.

PROGRAM CARTRIDGE



The PROGRAM CARTRIDGE performs the function of permanently storing the microprocessor instructions for a particular application, i.e., a game or a check book balancing program. It consists of two 4K ROM's mounted on a small PCB. Information is retrieved from the ROM's by sending an address on the address lines which selects a specific location in one of the ROM's. The data in this location is then sent out on the data lines.

KEYBOARD

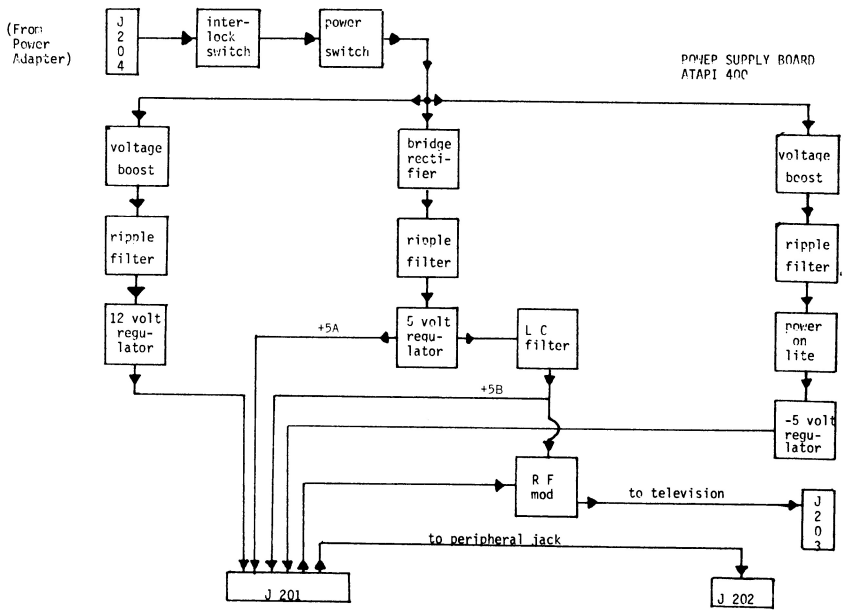


Graphic Symbols

Alpha Numerics

The KEYBOARD generates special graphic symbols as well as alphanumerics to allow the operator to communicate with the system for writing programs or responding to pre-programmed cassettes and cartridges. It consists of fifty-seven normally open switches that are scanned at a rapid rate. When a switch is found closed, that scan pattern is sent to the microprocessor for encoding.

POWER SUPPLY



The POWER SUPPLY receives 9V AC from the external power adaptor (transformer) and provides +5, +12, and -5 volts for the console. The power on-off switch is mounted here and removes power by opening the 9V AC line. An additional interlock switch cuts power when the operator opens the cartridge door to install or remove a cartridge.

Voltages:

+5 — Supply voltage for the logic boards.

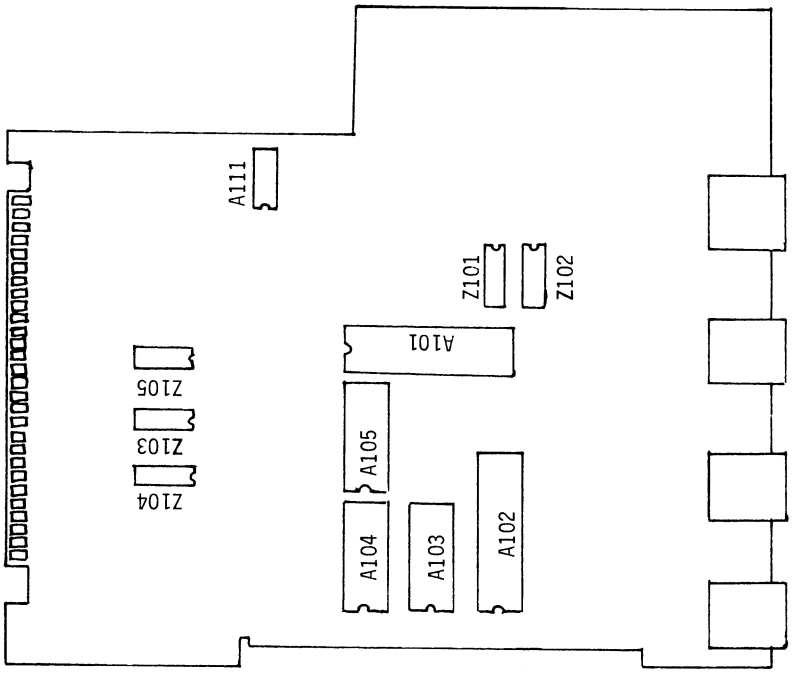
+5B — Specially filtered 5V line for the video circuitry.

-12 & -5V — Supply voltage used only by the dynamic RAM on the RAM Board.

Additional Functions:

1. Mounts the "Power On" indicator lights.
2. The RF module generates the RF output for a television from the composite video signals sent from the MOTHER BOARD, and is switchable to TV. Channel 2 or 3.
3. Passes all data and control signals for peripherals from the MOTHER BOARD directly to the peripheral port.

MOTHER BOARD



The MOTHER BOARD performs the function of typing together the various parts of the computer system, as well as performing a variety of logic functions. Logic boards, power supply, keyboard, program cartridge, peripherals, and hand controller accessories all connect to the MOTHER BOARD.

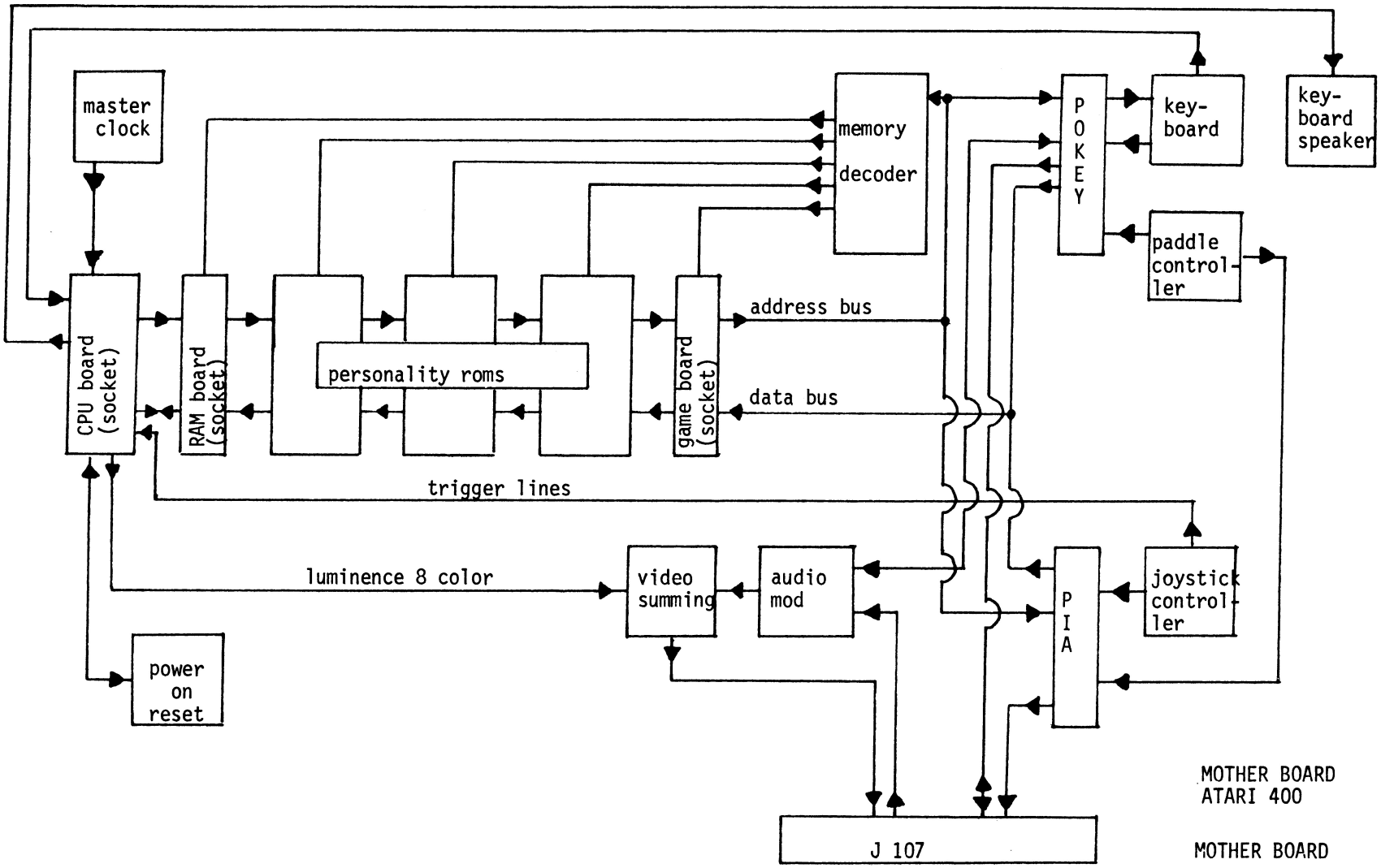
The personality section performs the function of permanently storing the program of operating instructions for the microprocessor. Two 4K ROM's store the microprocessor's program (called the operating system), and one 2K ROM contains arithmetic functions for use with basic programming. Information is retrieved from the ROM's by sending an address on the address lines which selects a particular location in a particular ROM. The data in this location is then sent out on the data lines.

Logic Functions:

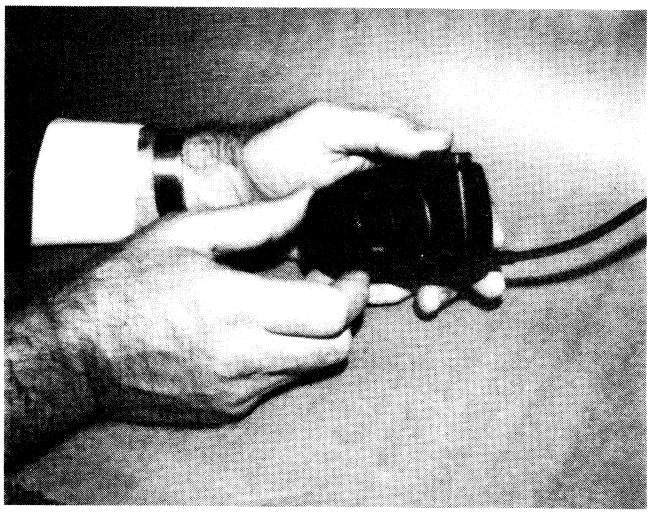
1. Generates 3.58MHZ master clock for the CPU BOARD.
2. Generates power on reset for the CPU BOARD.
3. Parallel/serial data conversion between the CPU BOARD and the peripherals.
4. Provides driving circuitry for the key press signal from the CPU BOARD to the speaker.
5. Converts signals from the hand controllers into data for the microprocessor.
6. Performs the first memory map decoding of the possible 64K address locations down to 8K blocks for the microprocessor.
7. Generates control signals for the peripherals.
8. Combines the sound from the computer system and the audio track of pre-recorded cassettes.
9. Develops the sound subcarrier for the TV audio as part of the composite video.

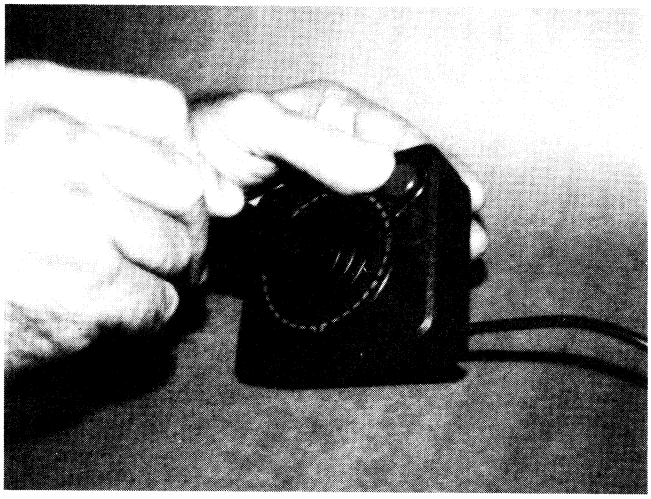
Additional Functions:

1. Passes the "trigger lines" from the hand controller fire buttons to the CPU BOARD.
2. Passes the signals from the four control switches to the right of the KEYBOARD to the CPU BOARD.


master clock
memory decoder
P O K E Y
key-board
key-board speaker
paddle control-ler
CPU board (socket)
RAM board (socket)
personality roms
game board (socket)
address bus
data bus
trigger lines
luminence 8 color
video summing
audio mod
P I A
joystick control-ler
power on reset
J 107
MOTHER BOARD ATARI 400
MOTHER BOARD ATAR

HAND CONTROLLER ACCESSORIES





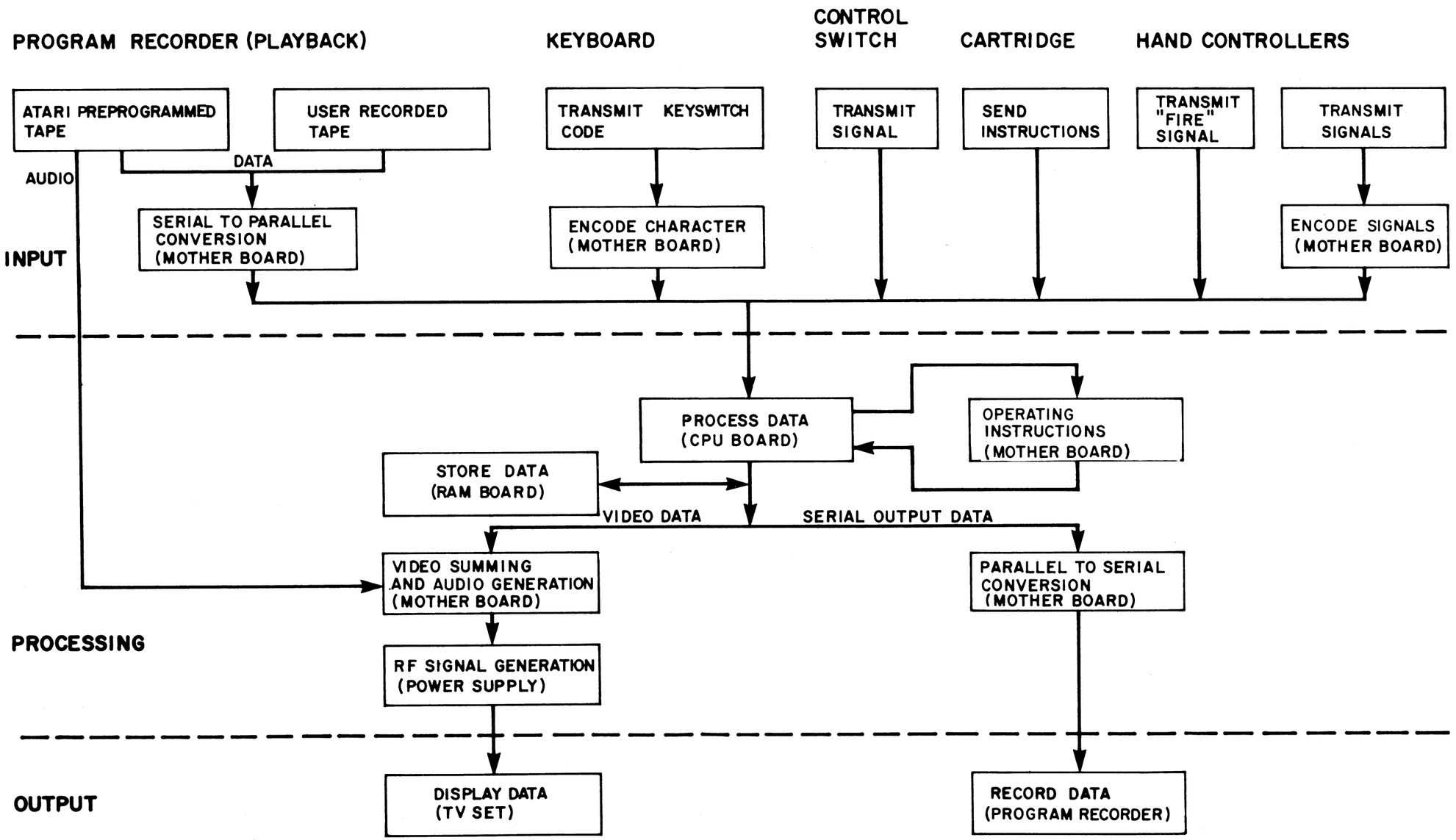
Joystick Controller — The joystick is mounted over four normally open switches evenly spaced in a circle. Moving the joystick "north", "east", "south", or "west", causes one of the switches to close, sending a logic low signal to the computer. Moving the joystick midway between two switches (such as north-east) causes both switches to close, thus giving the computer eight possible directions in a full circle of rotation. The fire button is mounted over a fifth normally open switch, and pressing it closes the switch to send a logic low signaling the computer to "fire".

Paddle Controller — The control knob is attached to a 100K OHM pot used as a rheostat. With one end tied to +5V, the varying voltage from the rheostat is sent to the console where an additional resistor and a capacitor form an RC network. The resulting varying RC time constant is used by the MOTHER BOARD to control the paddle. The fire button actuates a normally open switch to send a "fire" command to the microprocessor. Up to eight paddle controllers can be plugged into the console, two per jack.

Driving Controller — The controller knob is attached to a rotary switch which generates a 2 bit gray code. The 2 bit code allows four discrete positions to be decoded by the MOTHER BOARD, and the code is repeated four times in one full revolution allowing a total of sixteen positions. The progression of the gray code allows the console to determine which direction the knob is being rotated. The start button actuates a normally open switch to signal the microprocessor when to start and stop.

NOTES

ATARI 400 SYSTEM FLOW CHART



ATARI 400

SYSTEM SET UP

This section describes the proper set-up of the various components of the system. Part one is a quick checklist for each component listing the key points in its' proper set-up. Part two is a step-by-step procedure for installing each component. Many service calls are generated simply because the user has not set up his system properly.

Part One — Checklist

TV Switch Box

1. Antenna and RF cables connected properly, connections tight
2. Switch set to "computer"
3. TV fine tuning OK
4. TV set to same channel as console

Power Adaptor

1. AC outlet live
2. Power cord firmly seated in console

Console

1. Cartridge door closed (cuts power if open)
2. Power cord firmly seated
3. Channel select switch set to same channel as TV

Program Recorder

1. Data cord firmly seated
2. AC cord plugged in
3. AC outlet live

Hand Controllers

1. Multiple controllers added from left to right
2. Plugs firmly seated
3. Correct controller for the cartridge used

Program Cartridge

1. Cartridge door closed (cuts power if open)
2. Correct hand controller for the cartridge used

Part Two — Installation Set Up

TV Switch Box

1. Remove antenna wire from TV
2. Set TV to 300 OHM reception
3. Connect switch box antenna to TV (VHF)
4. Connect antenna wire to switch box
5. Connect console RF cable to switch box
6. Press adhesive backing to TV
7. Set switch box to "computer"
8. Set TV to channel 2 or 3 (whichever is weakest)
9. Check fine tuning

Power Adaptor

1. Plug into AC outlet
2. Plug low voltage power cord into console

Console

1. Set channel select switch on console to same channel as TV
2. Close cartridge door (cuts power if open)
3. Power on

Program Recorder (Optional)

1. Plug AC cord into AC outlet
2. Plug data cord into console peripheral jack

Hand Controllers

1. Plug into controller jack (polarized plug)
2. Add additional controllers from left to right

Program Cartridge

1. Fully seated in socket
2. Close cartridge door (cuts power if open)

ATARI 400

SYSTEM FAULT ISOLATION

This troubleshooting guide is used to isolate a defective module of the Atari 400 computer system and effect repairs by replacement. Two key points are emphasized here: first, the complexity of this type of equipment requires a careful assessment of proper system set-up and operation before any replacements are made. Second, consideration must be given to the users' own TV set as a possible source of the problem.

The troubleshooting guide lists symptoms together with the probable defective module(s). The following points are highly recommended to ensure an accurate and rapid repair:

1. Use only known good spares for substitution.
2. Observe the symptom has disappeared when the suspect module is replaced.
3. Observe the symptom re-appears when the suspect module is re-installed.
4. Modules with temperature related electronic failures need to be kept powered up as much as possible so they don't cool and loose their symptom.

SYSTEM FAULT ISOLATION

TROUBLESHOOTING GUIDE

SYMPTOM	DEFECTIVE MODULE
No picture when computer turned on (all snow)	1. Computer Console 2. Power Adaptor 3. TV Switchbox
Poor picture quality	1. Computer Console 2. TV Switchbox
All Black Screen	1. Computer Console
Sound Bad or Missing	1. Computer Console
Joystick Controller operates erraticly or not at all	1. Joystick Controller 2. Computer Console
Paddle Controller operates erraticly or not at all	1. Paddle Controller 2. Computer Console
Driving Controller operates Erraticly or not at all	1. Driving Controller 2. Computer Console
Program recorder operates Erraticly or not at all	1. Program Recorder 2. Computer Console 3. Cassette Tape
Erratic execution of a particular cassette tape	1. Cassette Tape 2. Computer Console
TV displays just vertical lines	1. Program Cartridge 2. Computer Console
Erratic execution of a particular program cartridge	1. Program Cartridge 2. Computer Console

CONSOLE FAULT ISOLATION

This section describes how to isolate faults in the console down to the defective board. The approach used is to replace one board at a time, starting with the most accessible boards, until the symptom has disappeared. After the repaired console is completely re-assembled it is given the complete stand-alone test to verify total system operation.

Fault Isolation Steps:

NOTE: Always Use A Known Good Set of Spares.

1. Ensure system set-up and operation are correct before investing time in trying to repair what may be a "non-problem".
2. Identify a specific and repeatable symptom. This can be:
   A. Console is dead—will not come up in memo pad mode
   B. Problem in operating the system directly
   C. System fails one of the test cartridges (see stand alone test procedures)
3. Replace the console PC Boards one at a time (Figure 3), then check for the symptom after each replacement. Replace the boards in the sequence listed below, referring to the removal/installation procedures for access to each board. Make sure power is off when inserting and removing boards to prevent damage.

   NOTE: Always leave the known good spares in the system until the defective board is isolated.

   A. Power Supply
   B. RAM Board
   C. CPU Board
   D. Mother Board
   E. Keyboard

   NOTE: TV picture interference is normal when the system is operated without the aluminum casting.
4. When the defective board is isolated, re-install it in the system to verify the defect. Very often the problem will be cleared up by reseating the board and it's I.C.'s in their sockets.

   CAUTION: Electronic failures due to heat problems will lose their symptoms if the board is allowed to cool.
5. Re-install all of the console's original boards (except for the defective board) and re-assemble the entire console.
6. Perform the complete stand alone test with the console completely assembled.

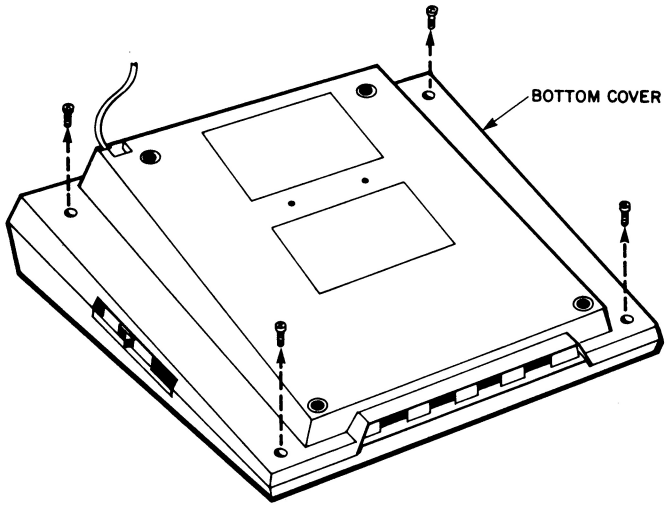
CONSOLE PC BOARD REMOVAL AND INSTALLATION PROCEDURES

This section describes the removal and installation of the PC boards for the console. Part one describes the removal procedures to gain access to each board. It progresses from the easiest access boards to the most difficult. Part two described the installation procedures and is organized to allow the re-assembly to pick up at whatever point was reached in the removal section.

Several Key Points Are Emphasized Here:

1. Be very careful about mixing screws when re-assembling. The plastic and aluminum parts will easily strip if the wrong size screw is used.
2. Excessive torque on screws will strip the plastic and aluminum parts.
   A. Plastic — 6 inch pounds torque max.
   B. Aluminum — 10 inch pounds torque max.
3. Protect the plastic surfaces of the console by working on a soft surface when the console is turned over on its back.
4. Use all static control precautions when handling any PC BOARD.

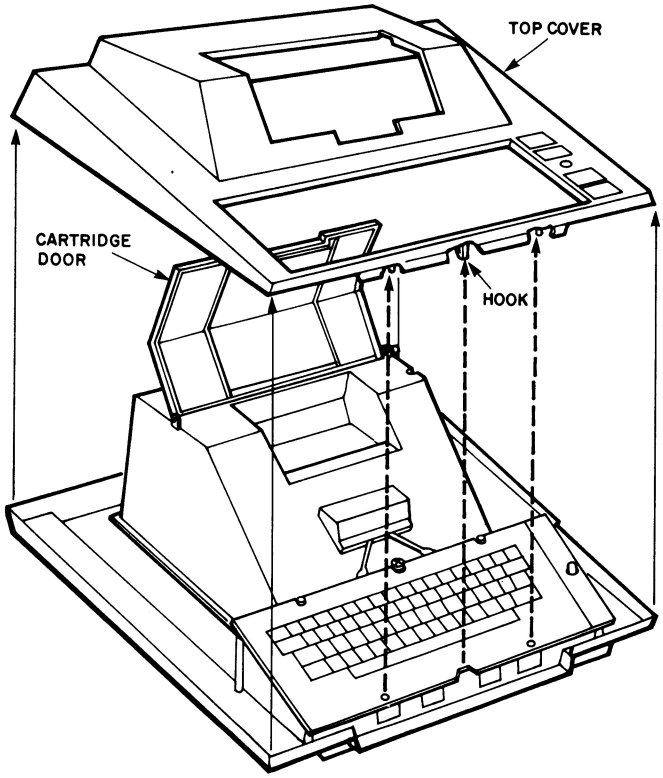
BOTTOM COVER SCREWS REMOVAL



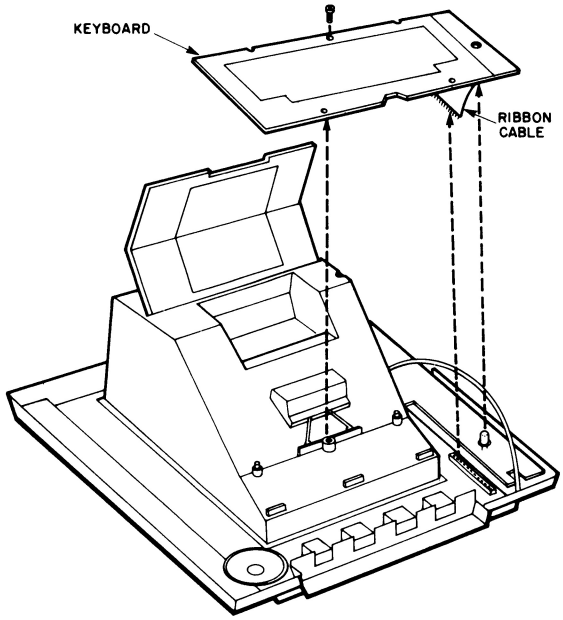
Access to KEYBOARD and POWER SUPPLY:

1. Top Cover Removal
   A. Set unit on its back
   B. Remove 4 screws (#6 20x½) from bottom cover
   C. Set unit on its feet
   D. Unhook top cover from KEYBOARD
   E. Open cartridge door
   F. Lift top cover off

TOP COVER REMOVAL

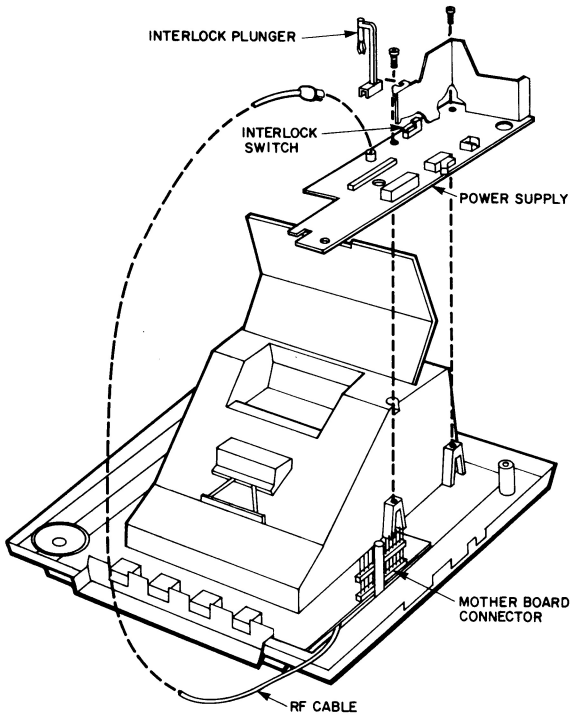


KEYBOARD REMOVAL



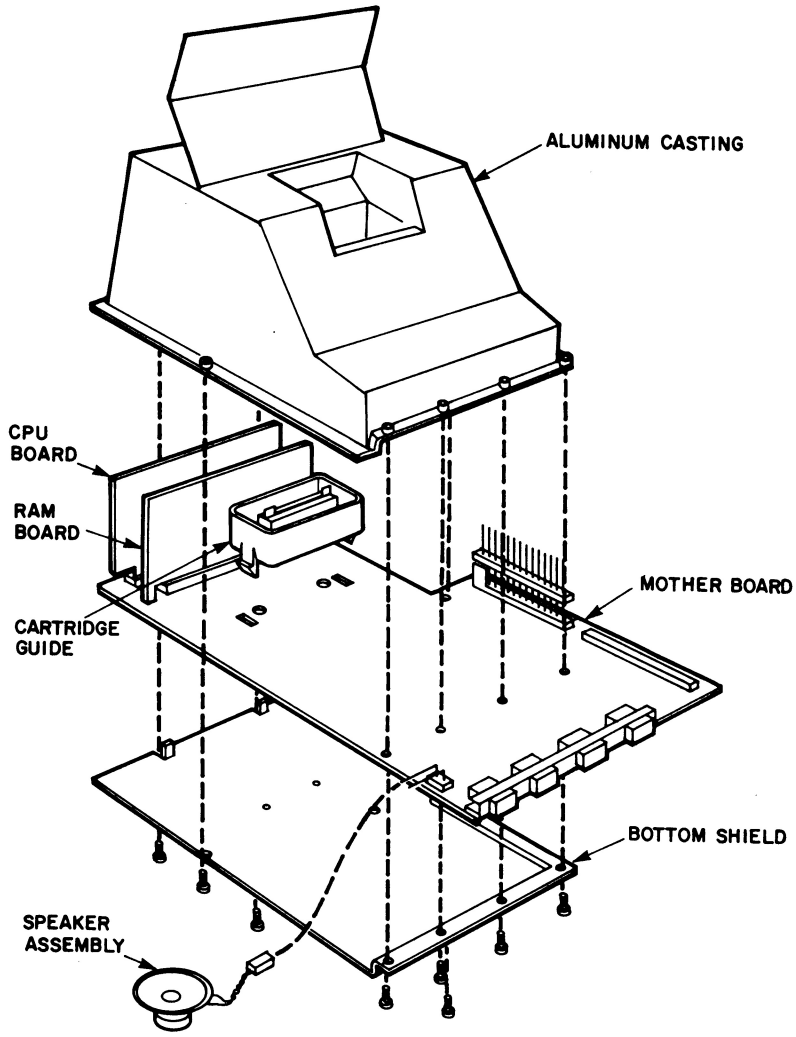
2. KEYBOARD Removal
   A. Remove single KEYBOARD screw (#6 32x¼).
   B. Raise left end of KEYBOARD and disconnect KEYBOARD ribbon cable.

POWER SUPPLY REMOVAL



3. POWER SUPPLY Removal
   A. Disconnect RF cable from POWER SUPPLY.
   B. Remove two screws (#6 32x⅜) from POWER SUPPLY.
   C. Gently pull POWER SUPPLY away from casting ¼ inch and lift out the interlock switch plunger.
   D. Lift POWER SUPPLY straight up off the mother board connector pins.

MODULE ASSEMBLY



1. Module Assembly Removal
   A. Disconnect and remove speaker assembly.
   B. Lift module assembly out of bottom cover.
2. CPU and RAM BOARD Removal
   A. Close and latch cartridge door.
   B. Set module assembly on its back.
   C. Remove 8 screws (#6 32x3/8) from bottom shield and lift off.
   D. Lift board asembly out of aluminum casting.
   E. Unplug CPU and/or RAM BOARD.
3. MOTHER BOARD Removal — Unhook and remove plastic cartridge guide.

STAND ALONE TEST

This is a series of tests to determine the proper operation of the Atari 400 Computer Console. The console must be operating well enough to come up in the "memo pad" mode before any of these tests can be performed.

Memo Pad Mode:

1. No cartridge in cartridge slot.
2. Cartridge door closed (cuts power if open).
3. Power on.
4. TV displays "Atari Computer — Memo Pad" in upper left hand corner.

Material Required:

1. Stand Alone Test cartridge.
2. Controller port jumper assembly.
3. Peripheral port jumper assembly.
4. Small slotted blade screwdriver.

Test Set-Up:

1. Insert the Stand Alone Test cartridge in the cartridge slot.
2. Plug the controller port jumper assembly into the controller ports.
3. Plug the peripheral port jumper assembly into the peripheral port.

Test Procedure: Command letters for each test are entered on the keyboard followed by "Return".

TEST #1 — VIDEO TEST

This tests the video generation circuitry three ways:

1. Video is generated (Any Video Test).
2. Proper color is generated (Color Bars Test).
3. Proper brightness is generated (Grey Bars Test).

Any Video Test:

Command Letter — "A"

Test Results—TV display should look like Figure 10

Color Bars Test:

Command Letter — "C"

Test Results—TV display should look like Figure 11

A. A 15 color bar rainbow is displayed above a grey reference bar, with a single color bar below.
B. Actual color displayed immediately above and below the grey reference bar is controlled by the tint control of the TV set.
C. Proper color adjustment makes the color bar immediately above and below the grey reference bar identical. See color bar adjustment procedure if adjustment is required. (Page 6-6)

Grey Bars Test:

Command Letter — "G"

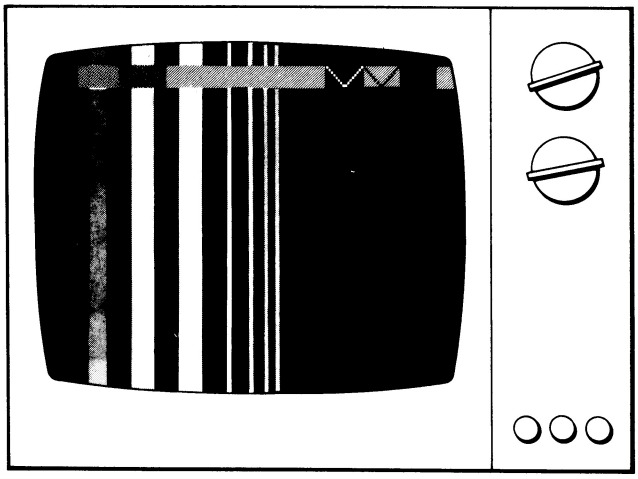
Test Results—TV display should look like Figure 12

A. Screen is divided into 8 equal horizontal bars
B. Bars start black at the top to white at the bottom in gradual shades.

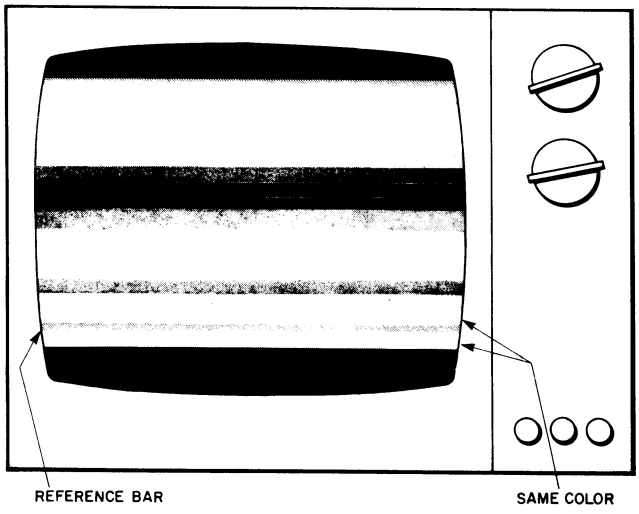
Color Bar Adjustment Procedure:

1. Console power switch on.
2. Run the color bars test (Command — "C").
3. Use a small screwdriver to adjust the pot inside the aluminum casting. The access hole is located at the rear of the aluminum casting and is accessible by inserting a small slotted screwdriver between the ventilation fins of the top cover (Figure 13).
4. Proper adjustment is to make the color bars immediately above and below the reference bar identical.

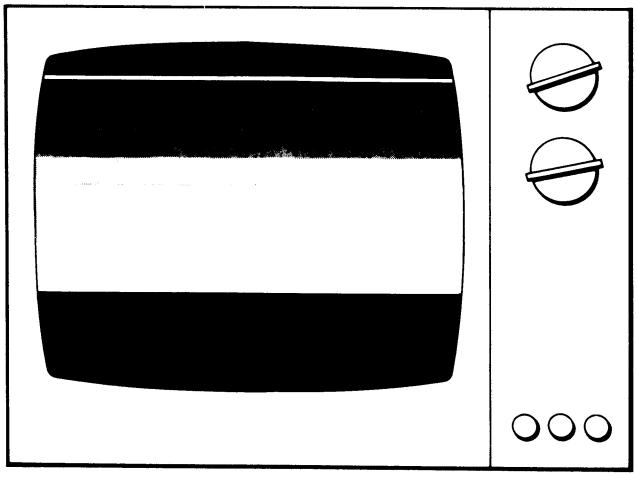
"ANY VIDEO"



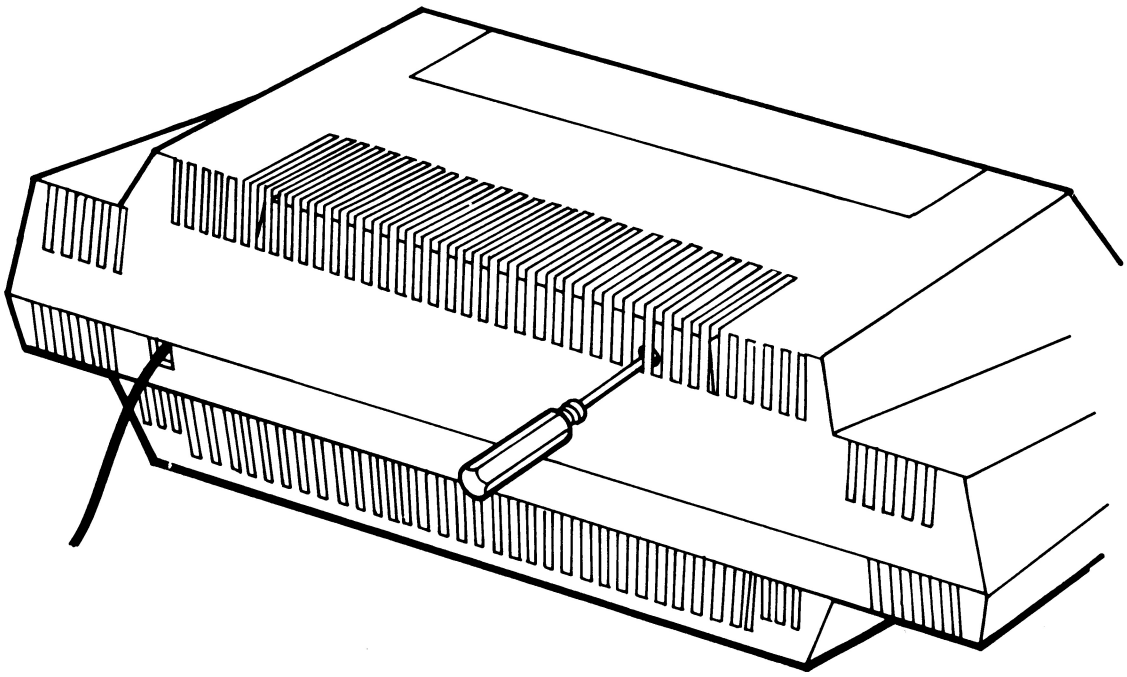
COLOR BARS



GREY BARS



COLOR BAR ADJUSTMENT



COLOR BAR ADJUSTMENT HOLE

TEST #2 — PORT TEST

This tests the controller and peripheral ports to verify they can input and output data, as well as the systems ability to process that data.

Command Letter — "P"

Test Results — TV will display a pass/fail message:

"PORT TEST PASS"
or
"PORT TEST FAIL"

TEST #3 — RAM TEST

This test verifies the proper operation of either 8K or 16K RAM BOARDS.

Command Letter — "R"

NOTE: The system must be advised of how many 8K "Blocks" of RAM are to be tested (not 8K or 16K RAM BOARDS). Enter the number of 8K "Blocks" to be tested from the KEYBOARD (1 or 2) then "Return"

EXAMPLE: One 16K RAM BOARD = 2 8K "Blocks" of RAM — enter "2", then "Return".

Test Results — After approximately 5 seconds of test time for each 8K "Block", the TV will display a pass/fail message:

"RAM TEST PASS"
or
"RAM TEST FAIL"

CONTINUOUS TESTING

The system may be set for continuous testing of whatever test is selected until stopped by the operator. Enter the command letters in the following order:

Command Letter — "D" (To Display Options)
Command Letter — "P" (For Pass/Fail Display)
Command Letter — "C"
(For Continuous Testing)

The port ("P") or RAM ("R") test can now be run, and will run continuously until stopped. To stop the test, press the "Option" control switch.

TEST #4 — TONE TEST

This tests the sound generation circuits and each of the 4 sound registers for tone and volume control.

Command Letter — "T"

NOTE: The system must be advised of which sound register is to be tested. Enter a number from 1 to 4 then "return" to begin the test.

Test Results — 8 tones are generated in succession, starting with the highest pitch down to the lowest.

A. The first 3 tones are very high frequencies and may be inaudible to some people.
B. Each tone starts at maximum volume and "fades" to minimum volume.
C. The complete test should be run for each of the 4 sound registers.

TEST #5 — KEYBOARD TEST

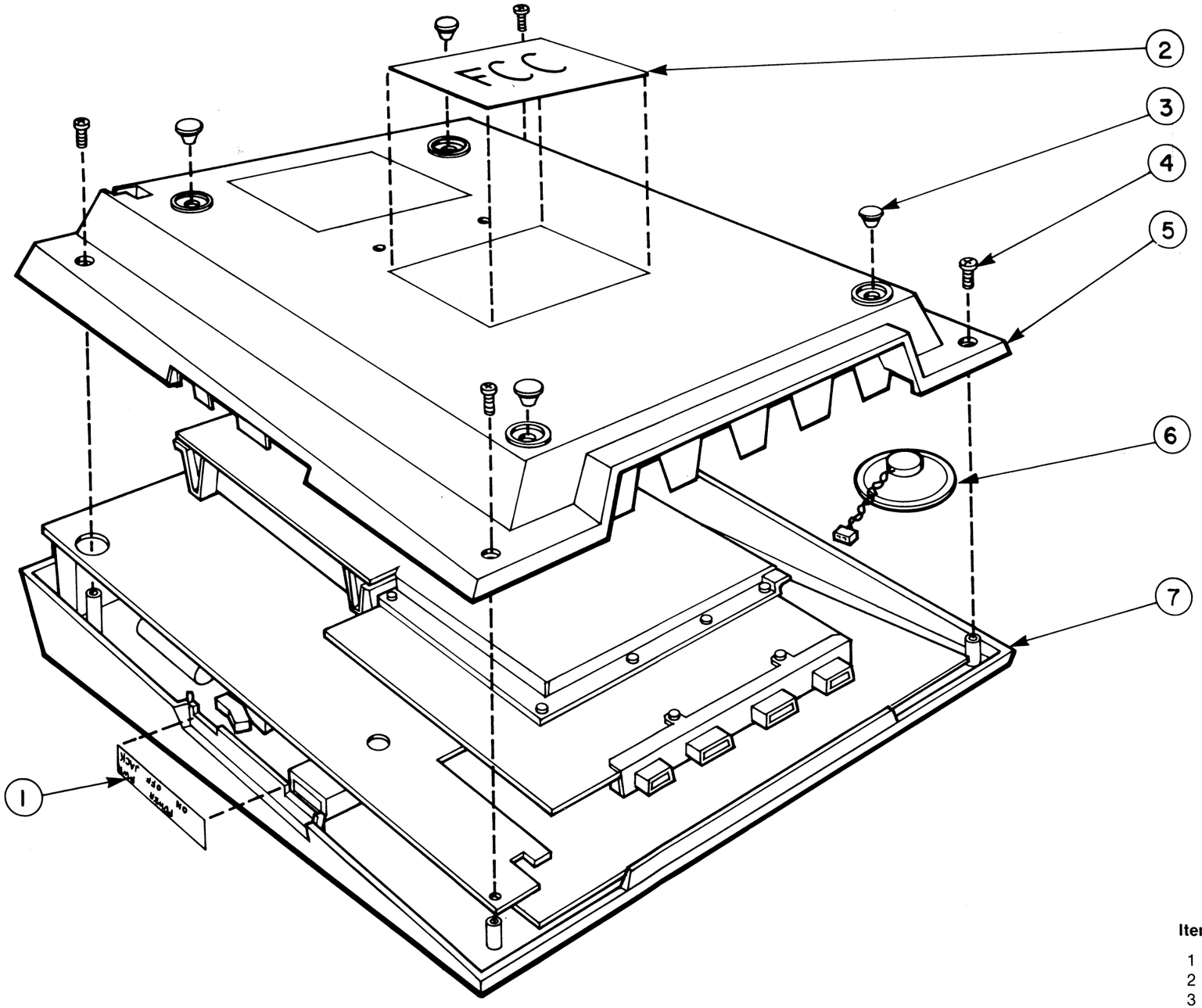
This test verifies the proper operation of the keyboard by typing on the keys and observing the TV display.

1. Power system up with no cartridges in cartridge slots.
2. Type each of the character keys and observe their TV display is correct (See owners manual).
   NOTE: Keys with two characters on them will print the lower character only.
3. Type these keys to cause a carriage return and line feed:
   RETURN
   BREAK
   TAB
4. Press "ESC" twice to print "E"
5. Press spacebar to move the cursor to the right one space.
6. Press "Delete/Back S" to move the cursor to the left one space.
7. Press "Caps/Lower", then type alphabet keys to print lower case.
8. Hold left then right "shift" keys with any alphabet character to print upper case.
9. Press the inverse video key (the one with the Atari logo) then type any character inverse video.
10. Hold down "CTRL" (control) key and press "=" to move cursor down.
11. Press system reset to clear screen—TV will display "Atari Computer-Memo Pad".

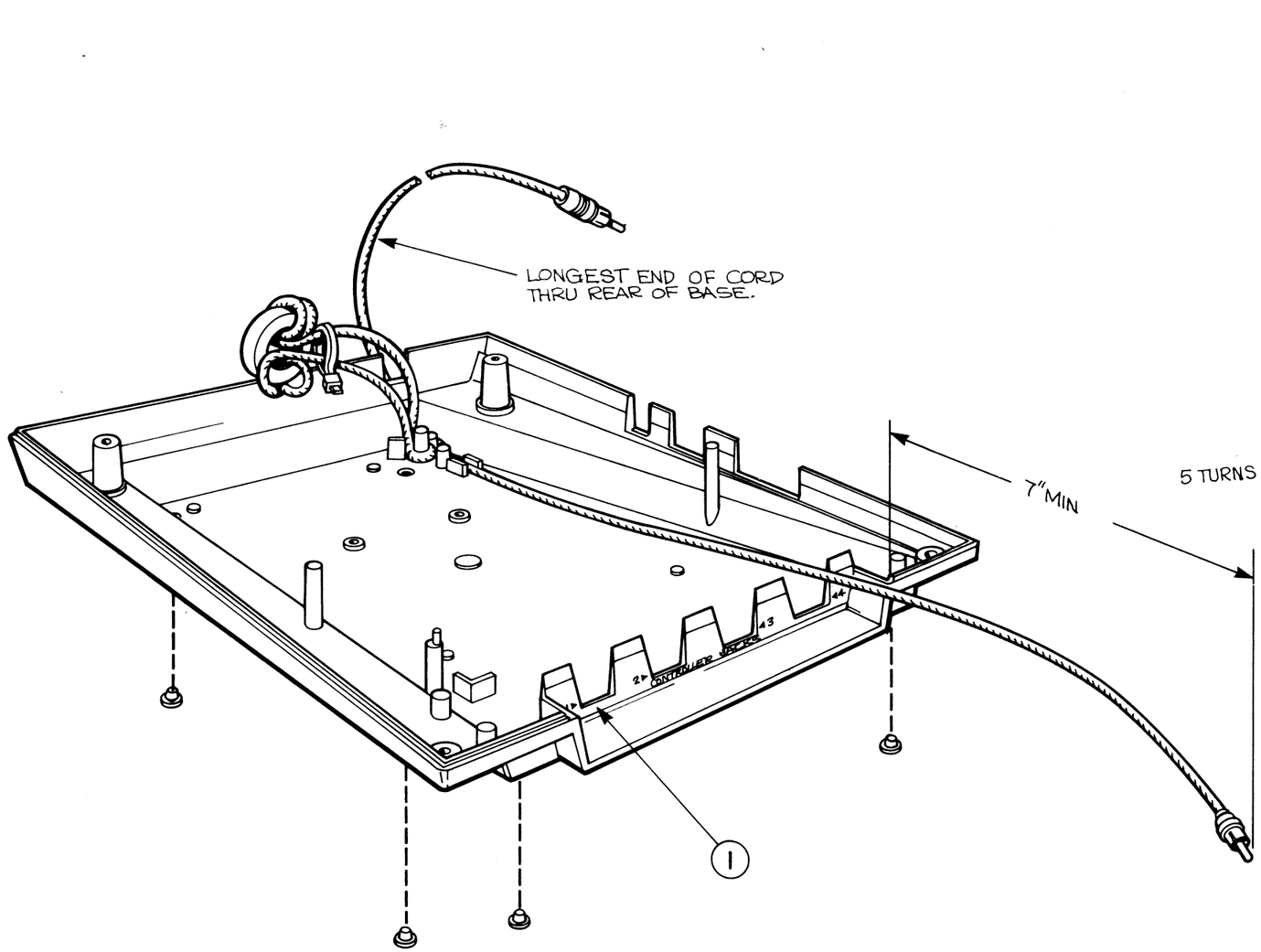
APPENDIX C

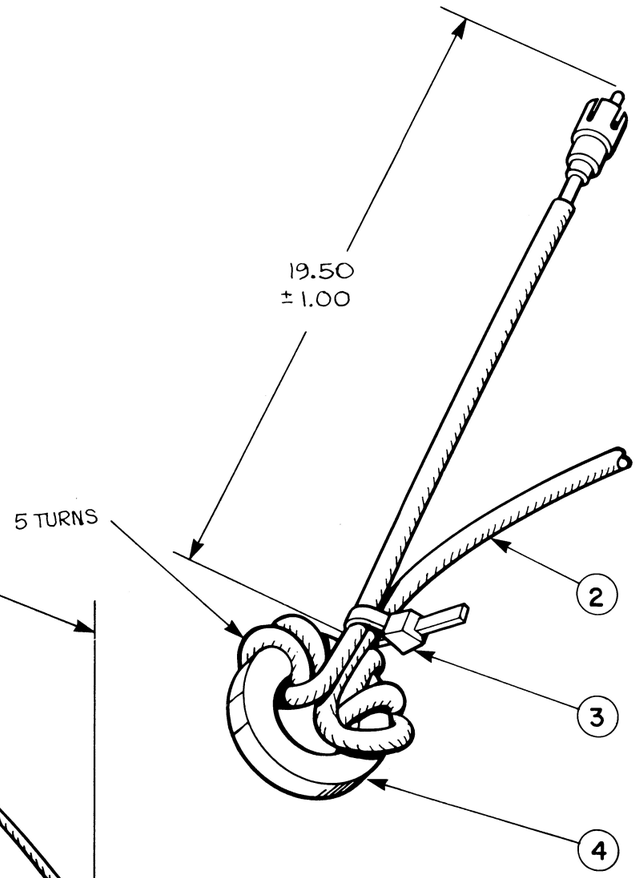
ATARI 400 TEST EQUIPMENT

1. Stand alone test cartridge.
2. Controller port jumper assembly.
3. Peripheral port jumper assembly.

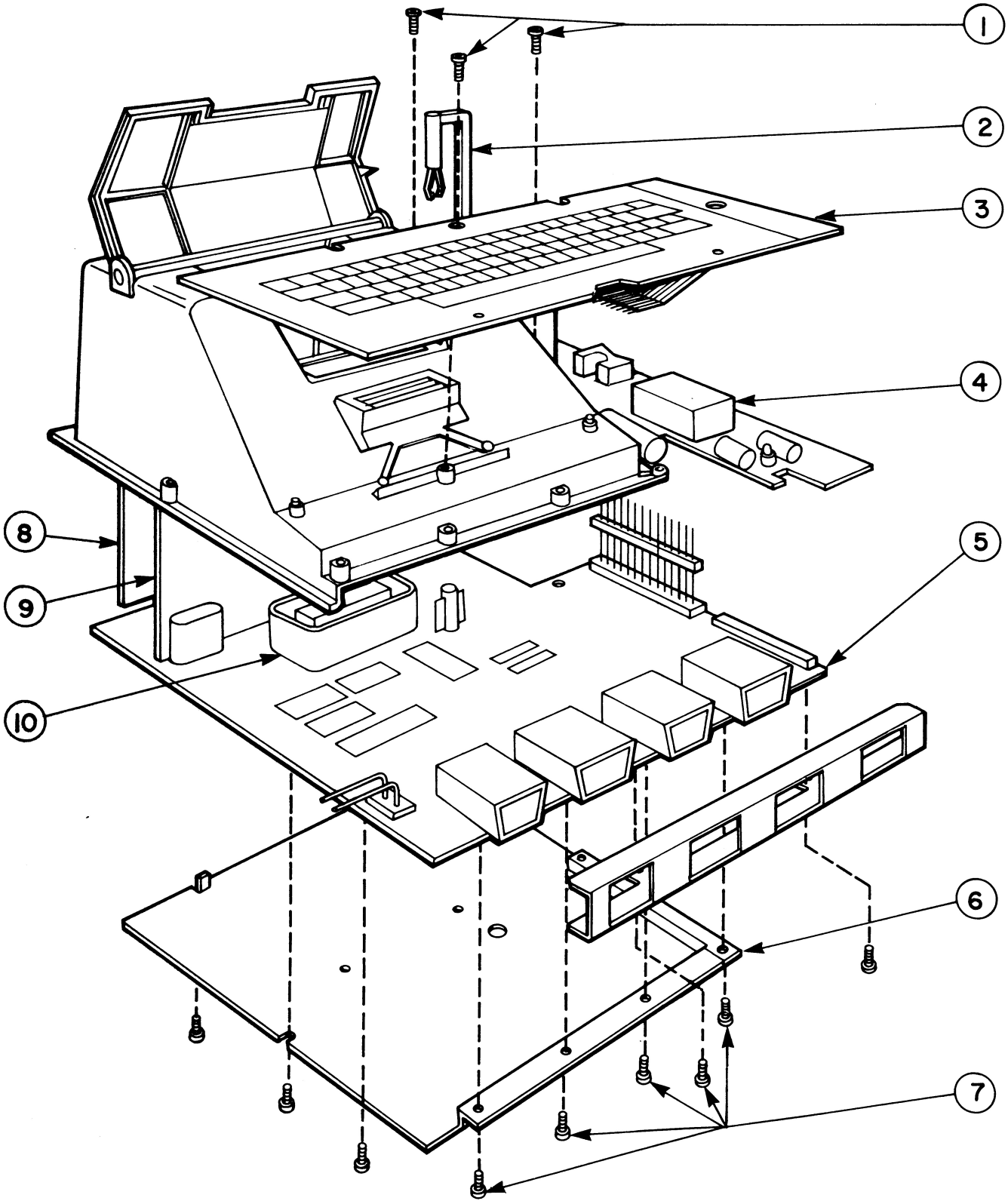


Item #	Description
1	Power Switch Label
2	FCC Label
3	Rubber Feet
4	Screws #6 20x½ PH HD
5	Console base
6	Speaker Assembly
7	Top Cover Assembly

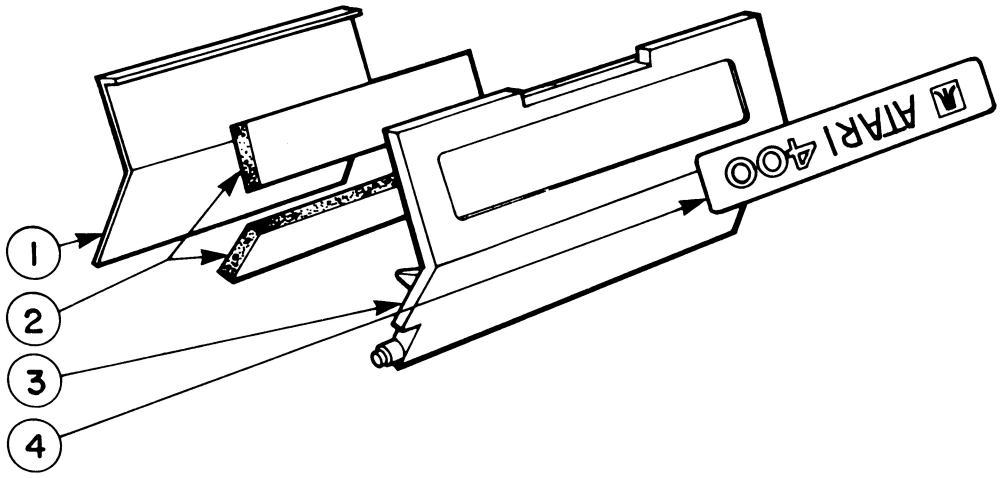


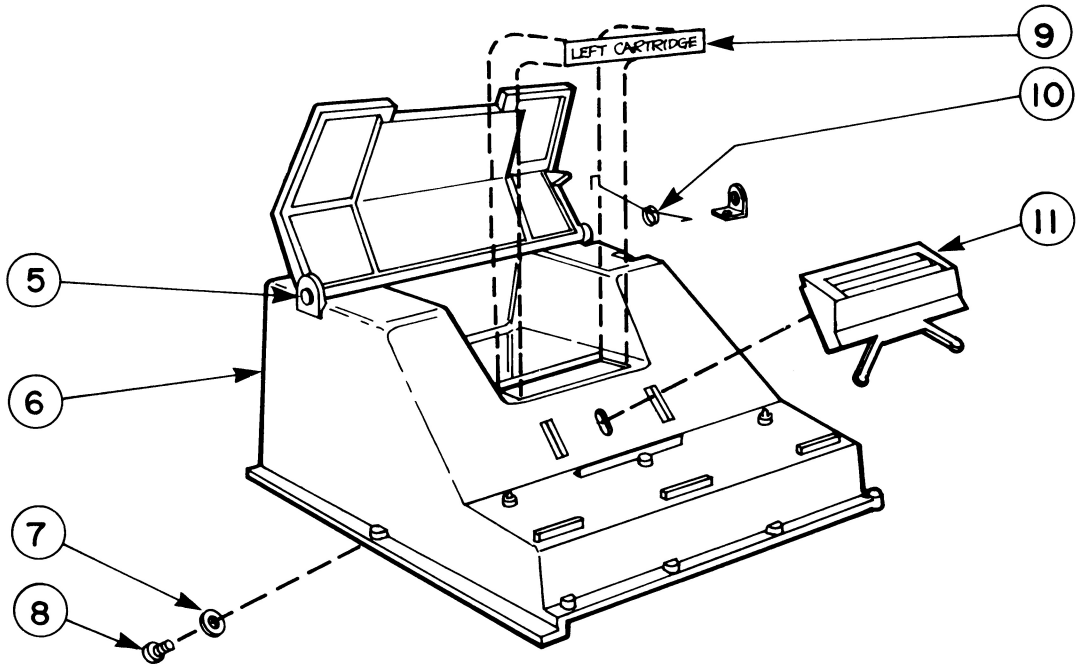


Item #	Description
1	Control Panel Label
2	Coax Cable
3	Cable Tie
4	Torroid Core



Item #	Description
1	Screws #6 32x⅜
2	Switch Plunger
3	KEYBOARD Assembly
4	POWER SUPPLY PCB
5	MOTHER BOARD
6	Bottom Shield
7	Screws #6 32x⅜
8	CPU BOARD
9	RAM BOARD
10	Cartridge Guide





Item #	Description
1	Door Shield
2	Foam Pads
3	Door
4	Door Label
5	Hing Bracket (2)
6	Module Casting
7	Washer, Nylon
8	Screw #6 32x¼
9	Insertion Label
10	Cartridge Door Spring
11	Door Latch

CPU BOARD SIGNALS

Signal	A301	A302	A303	Z301	Z302	Z303	Z304	Finger #
D0	07	30	33	-	-	-	-	05
D1	06	31	32	-	-	-	-	E(5)
D2	05	32	31	-	-	-	-	06
D3	04	33	30	-	-	-	-	07
D4	37	40	29	-	-	-	-	F(6)
D5	36	39	28	-	-	-	-	H(7)
D6	35	38	27	-	-	-	-	J(8)
D7	34	37	26	-	-	-	-	08
A0	02	13	09	-	-	03	-	12
A1	01	12	10	-	-	05	-	14
A2	40	11	11	-	-	07	-	N(12)
A3	39	10	12	-	-	09	-	V(18)
A4	38	28	13	-	-	12	-	T(16)
A5	-	27	14	-	-	14	-	16
A6	-	26	15	-	-	16	-	19
A7	-	25	16	-	-	18	-	13
A8	-	24	17	-	-	-	03	15
A9	-	23	18	-	-	-	05	0(13)
A10	-	16	19	-	-	-	07	W(19)
A11	-	22	20	-	-	-	09	U(17)
A12	-	17	22	-	-	-	12	18
A13	-	18	23	-	-	-	14	20
A14	-	19	24	-	-	-	16	CC(25)
A15	-	20	25	-	-	-	18	24
02	30	29	-	-	09	-	-	21
01	-	8&3	-	-	-	-	-	22
R/W	33	14	-	13	-	-	-	Y(21)
COL	21	-	-	-	-	-	-	04
LUM 0	22	-	-	-	-	-	-	01
LUM 1	23	-	-	-	-	-	-	03
LUM 2	24	-	-	-	-	-	-	02
LUM 3	31	-	-	-	-	-	-	M(11)
C-SYNC	25	-	-	-	-	-	-	B(2)
OSC	28	-	-	-	-	-	-	C(3)
S3	15	-	-	-	-	-	-	S(15)
S2	14	-	-	-	-	-	-	R(14)
S1	13	-	-	-	-	-	-	11
S0	12	-	-	-	-	-	-	17
T3	11	-	-	-	-	-	-	L(10)
T2	10	-	-	-	-	-	-	10

(Continued)

CPU BOARD SIGNALS (cont'd)

Signal	A301	A302	A303	Z301	Z302	Z303	Z304	Finger #
T1	09	-	-	-	-	-	-	K(9)
T0	08	-	-	-	-	-	-	09
CS1	32	-	-	-	-	-	-	27
+12	-	-	-	-	-	-	-	EE(27)
+5	27	21	08	14	12	20	20	DD(26)
GND	03	01	1,21,38	7&5	07	10	10	FF(28)
RNMI	-	06	-	-	-	-	-	Z(22)
LP	-	04	-	-	-	-	-	A(1)
REF	-	08	-	-	-	-	-	D(4)
A RESET	-	36	-	-	-	-	-	X(20)
NMI	-	07	06	-	-	-	-	23
SYNC	-	-	07	-	-	-	-	BB(24)
IRQ	-	-	04	-	-	-	-	AA(23)
M RESET	-	-	-	-	-	-	-	25

PERSONALITY BOARD SIGNALS

Signal	A401	A402	A403	Z401	Z402	Z403	Finger #
D0	09	09	09	-	-	-	01
D1	10	10	10	-	-	-	A(01)
D2	11	11	11	-	-	-	02
D3	13	13	13	-	-	-	03
D4	14	14	14	-	-	-	B(02)
D5	15	15	15	-	-	-	C(03)
D6	16	16	16	-	-	-	D(04)
D7	17	17	17	-	-	-	04
A0	08	08	08	-	-	-	05
A1	07	07	07	-	-	-	07
A2	06	06	06	-	-	-	E(05)
A3	05	05	05	-	-	-	10
A4	04	04	04	-	-	-	K(09)
A5	03	03	03	-	-	-	09
A6	02	02	02	-	-	-	J(08)
A7	01	01	01	-	-	-	06
A8	23	23	23	-	-	-	08
A9	22	22	22	02	-	-	F(06)
A10	19	19	19	03	-	-	11
A11	18	18	18	05	-	-	L(10)
A12	-	-	-	06	-	-	12
A13	-	-	-	-	-	-	NC
A14	-	-	-	-	-	-	NC
A15	-	-	-	-	-	09	R(14)
S7	20	20	-	-	-	-	H
S6	-	-	20	04	-	-	M(11)
D6	-	-	-	09	-	-	W(19)
D5	-	-	-	10	-	-	X(20)
(PIA) CS	-	-	-	12	-	-	18
(POKEY) CS	-	-	-	13	-	-	19
(CTIA) CS	-	-	-	15	-	02	13
EXCEL	-	-	-	-	-	2,3,8 6,13	14
GBA	-	-	-	-	-	11	T(16)
GBA	-	-	-	-	03	12	15
R/W EARLY	-	-	-	-	01	-	U(17)
RAM S5	-	-	-	-	-	04	N(12)
RAM S4	-	-	-	-	-	05	P(13)
02	-	-	-	-	05	-	S(15)
WRITIME	-	-	-	-	06	-	16
RASTIME	-	-	-	-	08	-	V(18)
01	-	-	-	-	09	-	17
VCC	24	24	24	16	14	14	26
VSS	12	12	12	08	07	07	07

8K RAM BOARD SIGNALS

Signal	Z501	Z502	Z503	Z504	Z505	Z506	Z507	Z508	Z509	Z510	Z511	Z512	Finger #
D0	-	09	-	-	-	-	-	-	-	-	-	02	01
D1	-	12	-	-	-	-	-	-	-	-	02	-	A(01)
D2	-	07	-	-	-	-	-	-	-	02	-	-	02
D3	-	05	-	-	-	-	-	02	-	-	-	-	03
D4	-	14	-	-	-	-	-	-	02	-	-	-	B(02)
D5	-	16	-	-	-	-	02	-	-	-	-	-	C(03)
D6	-	18	-	-	02	-	-	-	-	-	-	-	D(04)
D7	-	03	-	-	-	02	-	-	-	-	-	-	04
A0	-	-	-	06	-	-	-	-	-	-	-	-	05
A1	-	-	-	03	-	-	-	-	-	-	-	-	07
A2	-	-	-	11	-	-	-	-	-	-	-	-	E(05)
A3	-	-	13	-	-	-	-	-	-	-	-	-	10
A4	-	-	10	-	-	-	-	-	-	-	-	-	J(08)
A5	-	-	2,6	-	-	-	-	-	-	-	-	-	09
A6	-	-	03	-	-	-	-	-	-	-	-	-	12
A7	-	-	-	05	-	-	-	-	-	-	-	-	06
A8	-	-	-	02	-	-	-	-	-	-	-	-	08
A9	-	-	-	14	-	-	-	-	-	-	-	-	F(06)
A10	-	-	14	-	-	-	-	-	-	-	-	-	11
A11	-	-	11	-	-	-	-	-	-	-	-	-	K(09)
A12	-	-	05	-	-	-	-	-	-	-	-	-	L(10)
R/W EARLY	05	-	-	-	-	-	-	-	-	-	-	-	16
REF	02	-	-	-	-	-	-	-	-	-	-	-	17
SEL	01	-	-	-	-	-	-	-	-	-	-	-	18
RASTIME	09	-	-	-	-	-	-	-	-	-	-	-	15
R/W LATE	-	-	-	-	03	03	03	03	03	03	03	03	13
VDD (+12)	-	-	-	-	08	08	08	08	08	08	08	08	21,Y(21)
VCC (+5)	14	20	16	16	09	09	09	09	09	09	09	09	19,W(19)
VBB (-5)	-	-	-	-	01	01	01	01	01	01	01	01	20,X(20)
VSS(GND)	07	10	08	08	16	16	16	16	16	16	16	16	22,Z(22)
02	-	-	-	11	-	-	-	-	-	-	-	-	14

1. The ram address signals from the address de-multiplexors to the RAM's are called "RAMAD".
2. The source of the signal is identified wth parenthesis ( ) around the pin number.

(Continued)

Signal	Z501	Z502	Z503	Z504	Z505	Z506	Z507	Z508	Z509	Z510	Z511	Z512
RAMAD 0	-	-	(04)	-	05	05	05	05	05	05	05	05
RAMAD 5	-	-	(07)	-	10	10	10	10	10	10	10	10
RAMAD 4	-	-	(09)	-	11	11	11	11	11	11	11	11
RAMAD 3	-	-	(12)	-	12	12	12	12	12	12	12	12
SEL Z503	03	-	-	(01)	04	04	04	04	04	04	04	04
SEL Z504	03	-	01	(01)	04	04	04	04	04	04	04	04
RAMAD 1	-	-	-	(04)	07	07	07	07	07	07	07	07
RAMAD 6	-	-	-	(07)	13	13	13	13	13	13	13	13
CAS	-	-	-	(09)	15	15	15	15	15	15	15	15
RAMAD 2	-	-	-	(12)	06	06	06	06	06	06	06	06
RAS	(08)	-	-	-	04	04	04	04	04	04	04	04

The data signals from the RAMS to the Tri-state Buffer (Z502) will be called "D(?) Out". The number in the parenthesis will be the output pin number of that RAM chip.

Signal	Z501	Z502	Z503	Z504	Z505	Z506	Z507	Z508	Z509	Z510	Z511	Z512
D6 OUT	-	02	-	-	(14)	-	-	-	-	-	-	-
D5 OUT	-	04	-	-	-	-	(14)	-	-	-	-	-
D4 OUT	-	06	-	-	-	-	-	-	(14)	-	-	-
D1 OUT	-	08	-	-	-	-	-	-	-	-	(14)	-
D0 OUT	-	11	-	-	-	-	-	-	-	-	-	(14)
D2 OUT	-	13	-	-	-	-	-	-	-	(14)	-	-
D3 OUT	-	15	-	-	-	-	-	(14)	-	-	-	-
D7	-	17	-	-	-	(14)	-	-	-	-	-	-

16K RAM BOARD SIGNALS

Signal	Z501	Z502	Z503	Z504	Z505	Z506	Z507	Z508	Z509	Z510	Z511	Z512
D0	XX	09	XX	XX	XX	XX	XX	XX	XX	XX	XX	02
D1	XX	12	XX	XX	XX	XX	XX	XX	XX	XX	02	XX
D2	XX	07	XX	XX	XX	XX	XX	XX	XX	02	XX	XX
D3	XX	05	XX	XX	XX	XX	XX	02	XX	XX	XX	XX
D4	XX	14	XX	XX	XX	XX	XX	XX	02	XX	XX	XX
D5	XX	16	XX	XX	XX	XX	02	XX	XX	XX	XX	XX
D6	XX	18	XX	XX	02	XX	XX	XX	XX	XX	XX	XX
D7	XX	03	XX	XX	XX	02	XX	XX	XX	XX	XX	XX
A0	XX	XX	XX	06	XX	XX	XX	XX	XX	XX	XX	XX
A1	XX	XX	XX	03	XX	XX	XX	XX	XX	XX	XX	XX
A2	XX	XX	XX	11	XX	XX	XX	XX	XX	XX	XX	XX
A3	XX	XX	13	XX	XX	XX	XX	XX	XX	XX	XX	XX
A4	XX	XX	10	XX	XX	XX	XX	XX	XX	XX	XX	XX
A5	XX	XX	2,6	XX	XX	XX	XX	XX	XX	XX	XX	XX
A6	XX	XX	03	XX	XX	XX	XX	XX	XX	XX	XX	XX
A7	XX	XX	XX	05	XX	XX	XX	XX	XX	XX	XX	XX
A8	XX	XX	XX	02	XX	XX	XX	XX	XX	XX	XX	XX
A9	XX	XX	XX	14	XX	XX	XX	XX	XX	XX	XX	XX
A10	XX	XX	14	XX	XX	XX	XX	XX	XX	XX	XX	XX
A11	XX	XX	11	XX	XX	XX	XX	XX	XX	XX	XX	XX
A12	XX	XX	05	XX	XX	XX	XX	XX	XX	XX	XX	XX
R/W EARLY	05	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
REF	02	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
SEL	01	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
RASTIME	09	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
R/W LATE	XX	XX	XX	XX	03	03	03	03	03	03	03	03
VDD	XX	XX	XX	XX	08	08	08	08	08	08	08	08
VCC	14	20	16	16	09	09	09	09	09	09	09	09
VBB	XX	XX	XX	XX	01	01	01	01	01	01	01	01
VSS	07	10	08	08	16	16	16	16	16	16	16	16
02	XX	XX	XX	11	XX	XX	XX	XX	XX	XX	XX	XX

The following are outputs of the address demultiplexers. The chips have been given a letter code, (Z503- "A"), (Z504-"B"). The outputs have been labeled by output pin on the multiplexers.

Example:
AD MUX A4 = Address Demultiplexer Z503 Pin 4 Output
AD MUX B4 = Address Demultiplexer Z504 Pin 4 Output

(Continued)

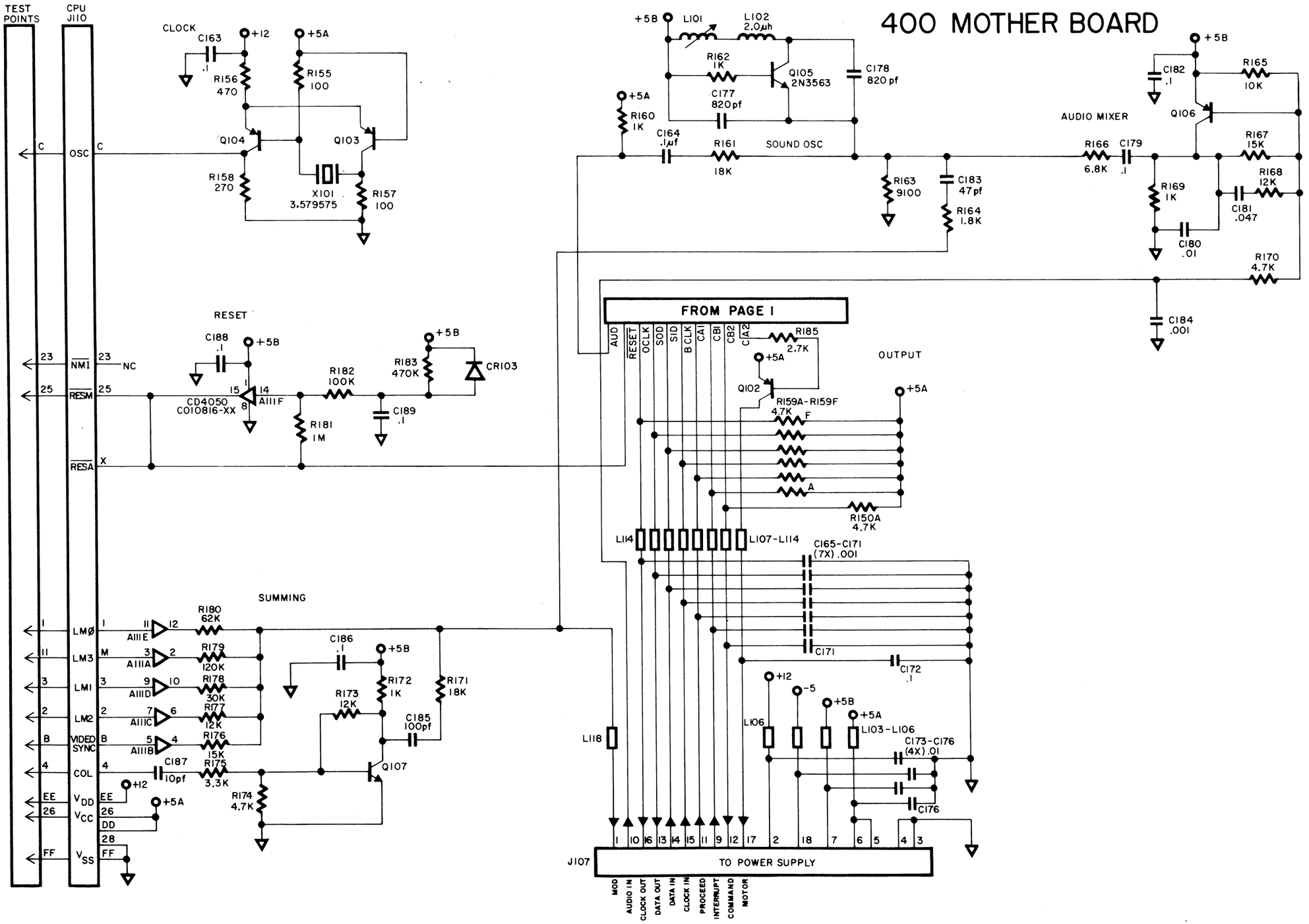
Signal	Z501	Z502	Z503	Z504	Z505	Z506	Z507	Z508	Z509	Z510	Z511	Z512
AD MUX A4	XX	XX	XX	XX	05	05	05	05	05	05	05	05
AD MUX A7	XX	XX	XX	XX	10	10	10	10	10	10	10	10
AD MUX A9	XX	XX	XX	XX	11	11	11	11	11	11	11	11
AD MUX A12	XX	XX	XX	XX	12	12	12	12	12	12	12	12
AD MUX A1	03	XX	XX	01	04	04	04	04	04	04	04	04
AD MUX B1	03	XX	01	XX	04	04	04	04	04	04	04	04
AD MUX B4	XX	XX	XX	XX	07	07	07	07	07	07	07	07
AD MUX B7	XX	XX	XX	XX	13	13	13	13	13	13	13	13
AD MUX B9	XX	XX	XX	XX	15	15	15	15	15	15	15	15
AD MUX B12	XX	XX	XX	XX	06	06	06	06	06	06	06	06

The following are inputs to the data tri-state buffer. The inputs have been labeled by input pin number on the tri-state buffer (Z502).

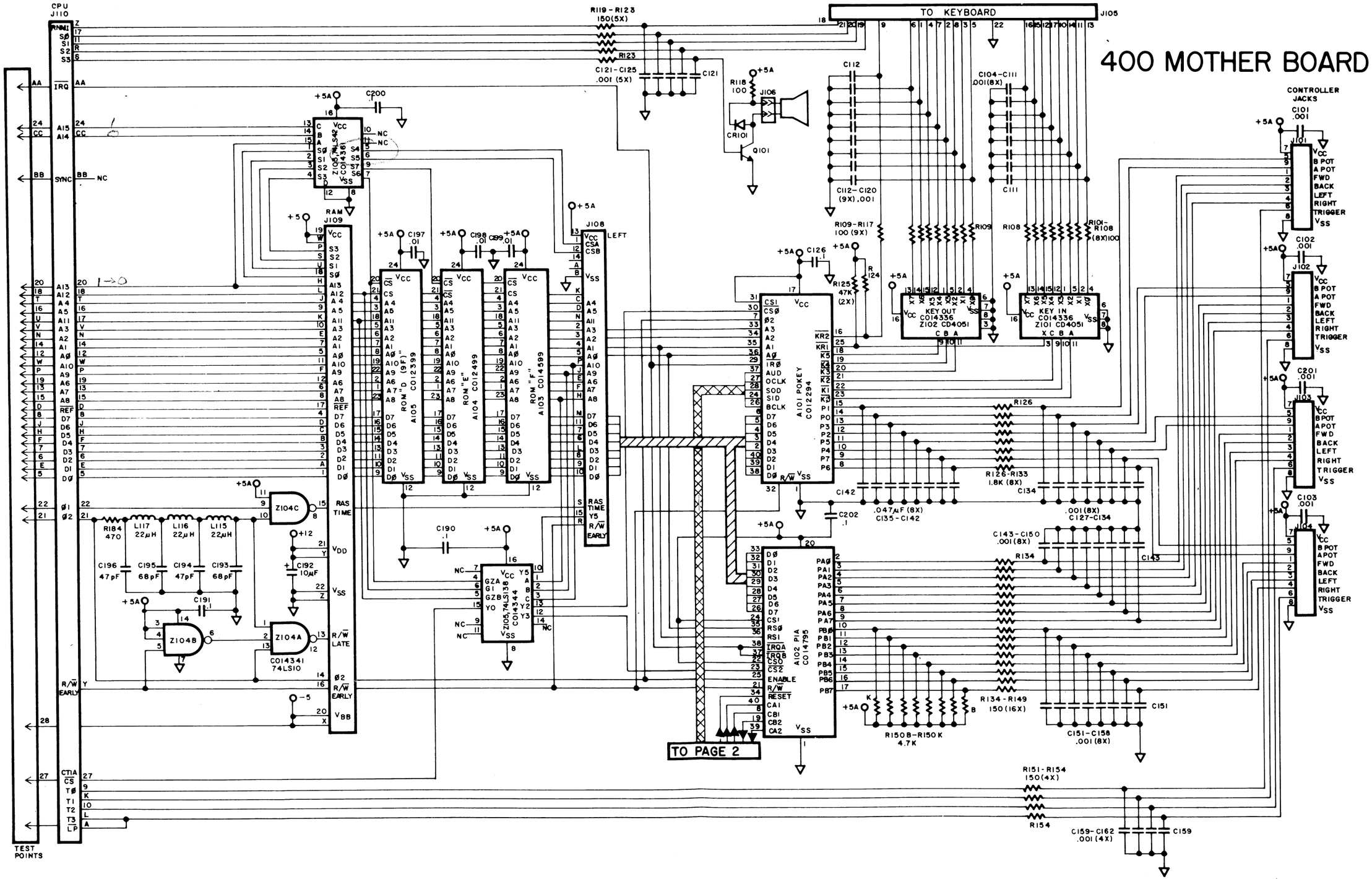
Example:
Data TRI 2 = Data Tri-state Buffer Input Pin 2
Data TRI 4 = Data Tri-state Buffer Input Pin 4

Signal	Z501	Z502	Z503	Z504	Z505	Z506	Z507	Z508	Z509	Z510	Z511	Z512
DATA TRI 2	XX	02	XX	XX	14	XX	XX	XX	XX	XX	XX	XX
DATA TRI 4	XX	04	XX	XX	XX	XX	14	XX	XX	XX	XX	XX
DATA TRI 6	XX	06	XX	XX	XX	XX	XX	XX	14	XX	XX	XX
DATA TRI 8	XX	08	XX	XX	XX	XX	XX	XX	XX	XX	14	XX
DATA TRI 11	XX	11	XX	XX	XX	XX	XX	XX	XX	XX	XX	14
DATA TRI 13	XX	13	XX	XX	XX	XX	XX	XX	XX	14	XX	XX
DATA TRI 15	XX	15	XX	XX	XX	XX	XX	08	XX	XX	XX	XX
DATA TRI 17	XX	17	XX	XX	XX	14	XX	XX	XX	XX	XX	XX

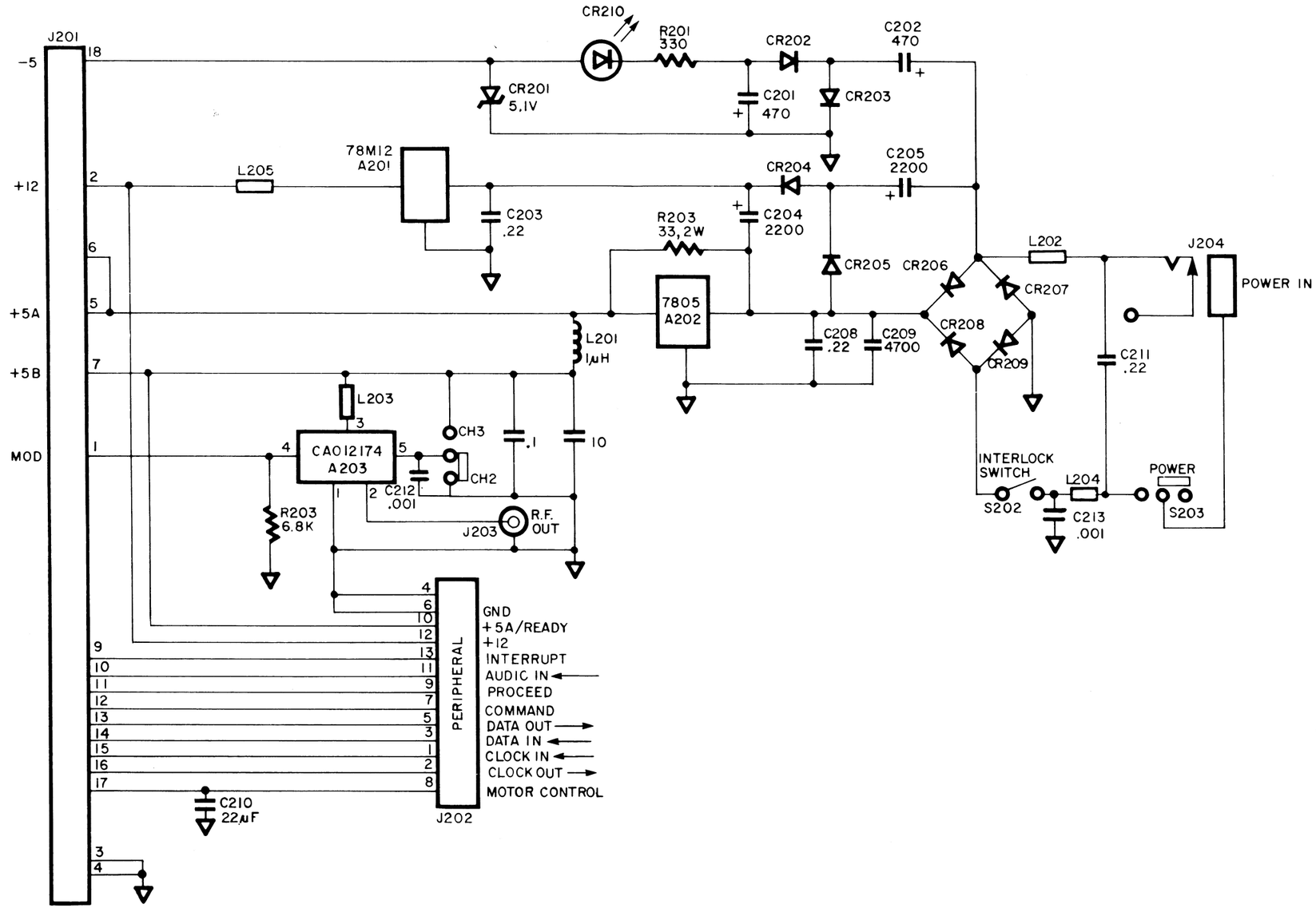
400 MOTHER BOARD



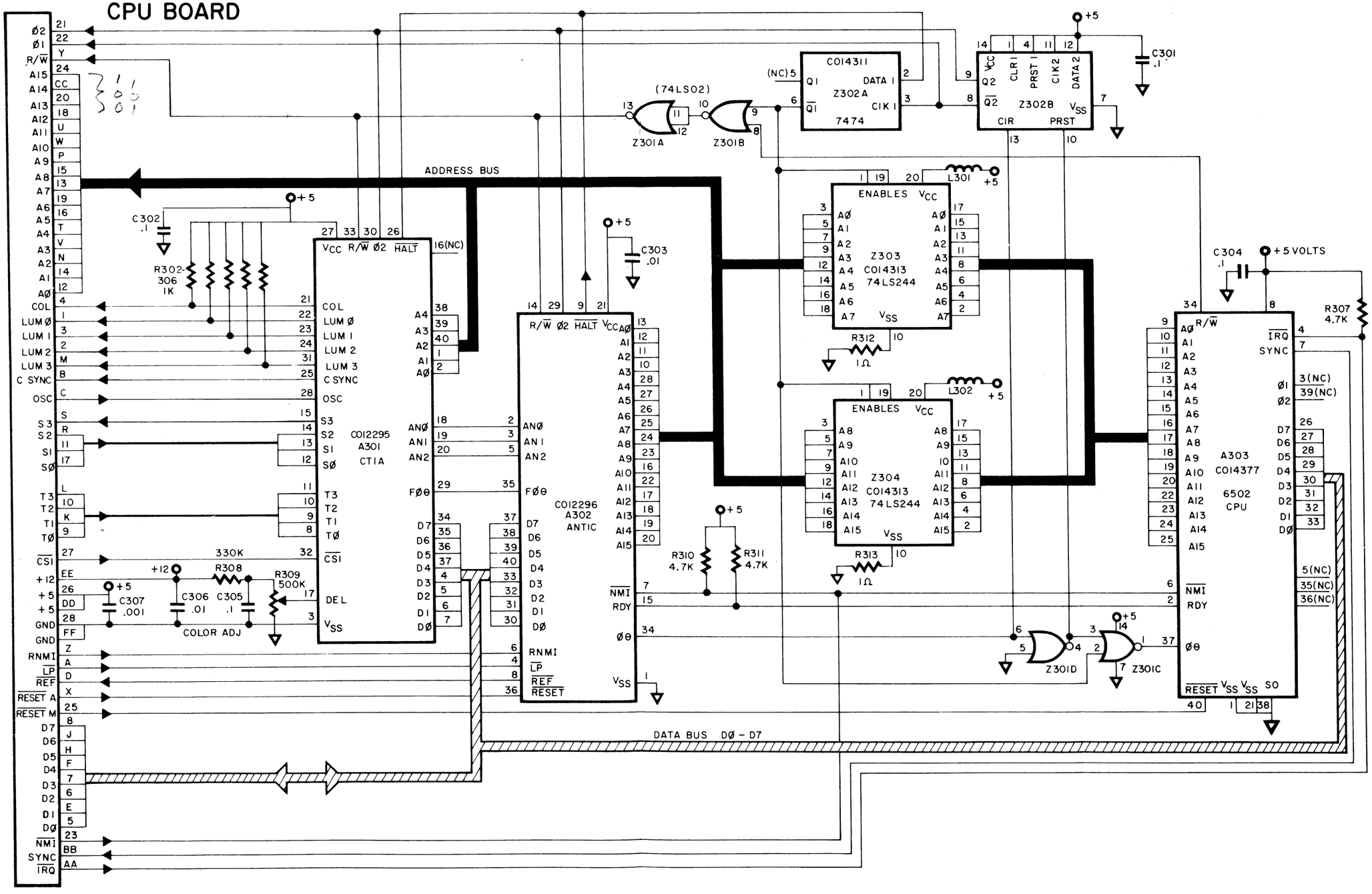
400 MOTHER BOARD



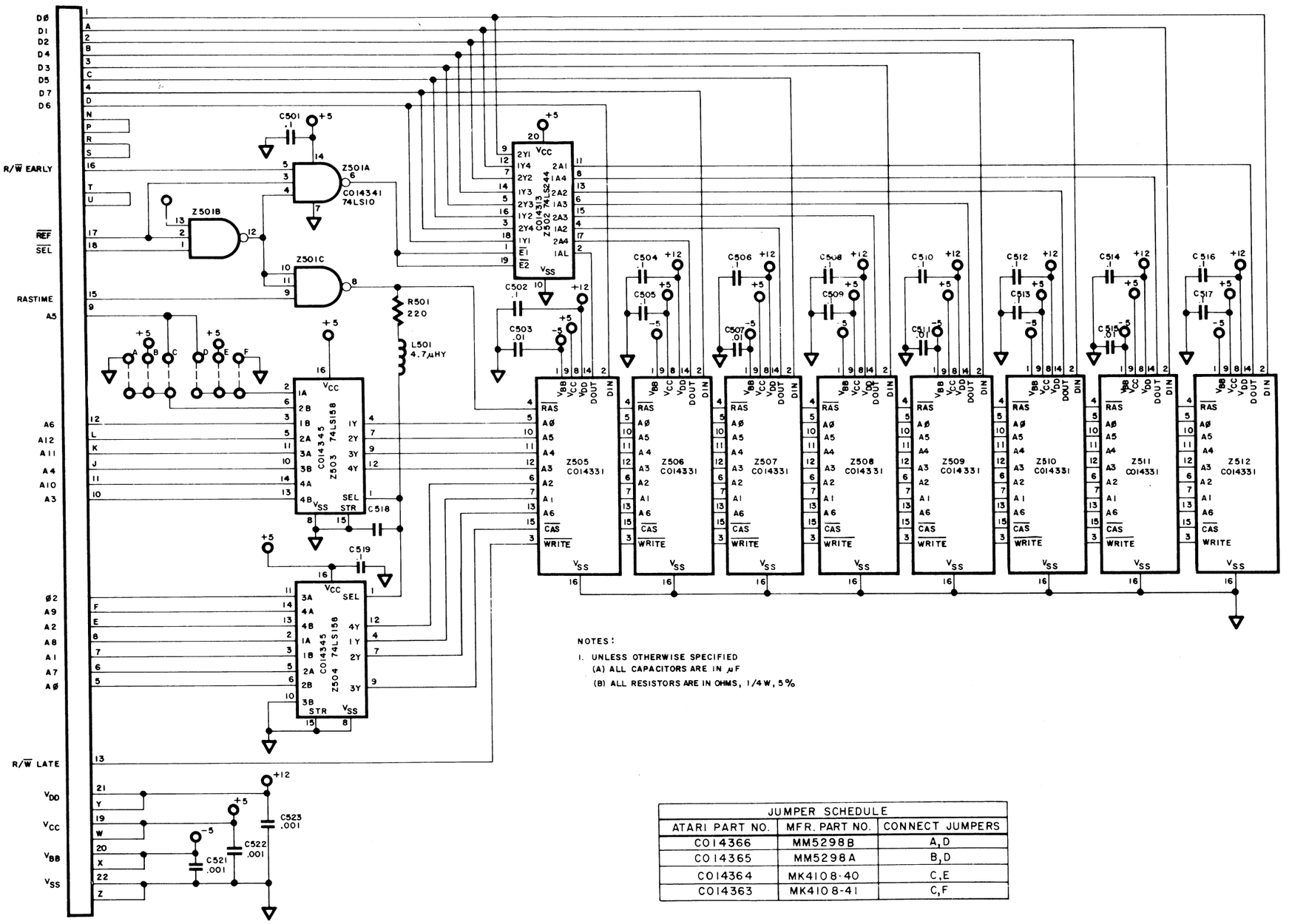
400 POWER SUPPLY



CPU BOARD


ADDRESS BUS
DATA BUS DØ – D7
(74LS02)
Z301A
Z301B
CO14311
Z302A
7474
Z302B
C301
C302
C303
C304
+5 VOLTS
R302-306 1K
R307 4.7K
R308
R309 500K
330K
COLOR ADJ
C306 .01
C305 .1
C307 .001
R310 4.7K
R311 4.7K
R312 1Ω
R313 1Ω
L301
L302
Z303 CO14313 74LS244
Z304 CO14313 74LS244
ENABLES
CO12295 A301 CTIA
CO12296 A302 ANTIC
A303 CO14377 6502 CPU
Z301D
Z301C
COL
LUM Ø
LUM 1
LUM 2
LUM 3
C SYNC
OSC
R/W Ø2 HALT
RNMI
NMI
RDY
IRQ
SYNC
RESET
DEL
COLOR ADJ

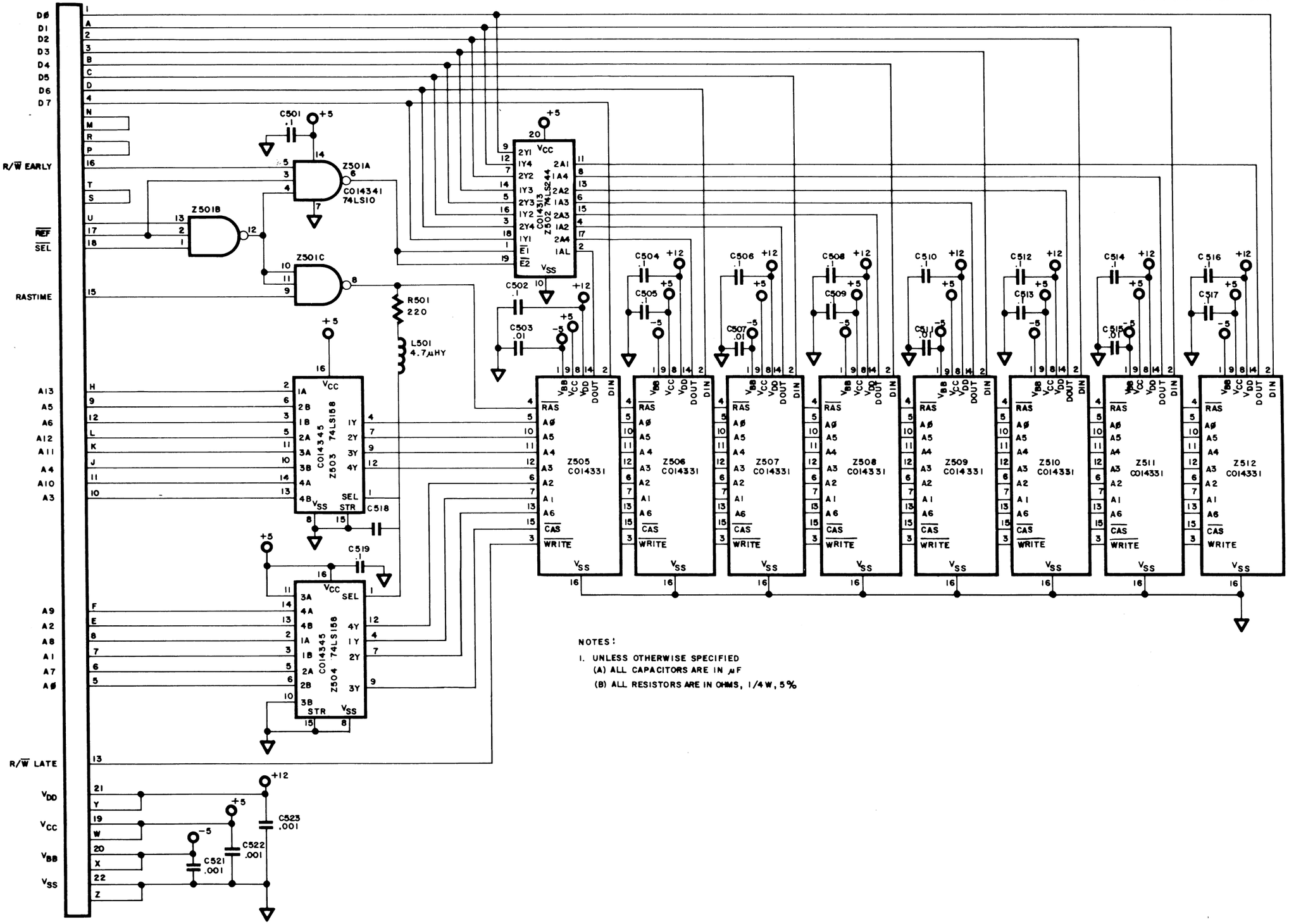
8K RAM



NOTES:

1. UNLESS OTHERWISE SPECIFIED
   (A) ALL CAPACITORS ARE IN µF
   (B) ALL RESISTORS ARE IN OHMS, 1/4W, 5%

JUMPER SCHEDULE		
ATARI PART NO.	MFR. PART NO.	CONNECT JUMPERS
C014366	MM5298B	A,D
C014365	MM5298A	B,D
C014364	MK4108-40	C,E
C014363	MK4108-41	C,F



NOTES:

1. UNLESS OTHERWISE SPECIFIED
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A QUICK REFERENCE GLOSSARY OF COMPUTER BUZZWORDS

Accumulator—A register which stores the results of a computer operation.

Adder—A combinational logic circuit that adds binary numbers

Address—A binary number that identifies a specific memory storage location.

Alphanumeric—A collection of characters containing both letters of the alphabet and numbers.

Analog Computer—A computer that uses variable voltages to represent numerical quantities. A specific analog computer is often designed to solve a relatively small number of problems.

Arithemetic-Logic Unit—A combinational logic circuit that performs both arithmetic and logical operations in a digital computer.

ASCII Code—An acronym for **A**merican **S**tandard **C**ode for **I**nformation **I**nter-change. A binary code that represents alphanumeric characters and various symbols.

Assembler—A computer program that automatically converts assembly language mnemonics into machine language.

Assembly Language—This next step above machine language. Substitutes easily remembered mnemonics such as LDA and CLR for binary machine language instruction such as 01100111.

Asynchronous—A computer operation that takes place whenever input information appears. The basic RS flip-flop, for example, is an asynchronous circuit.

BASIC—An acronym for **B**eginner's **A**ll-Purpose **S**ymbolic **I**nstruction **C**ode. A super-easy computer language you can learn in an hour or so. Used with most personal computers.

BCD—See Binary Coded Decimal.

Binary—A number system with the base two. Also, a general term used to describe a condition or electronic circuit which has only two states, usually on or off.

Binary Coded Decimal (BCD)—A number system used in digital computers and calculators that assigns a binary number to each of the ten decimal digits.

Binary Digit—The binary digits 0 or 1.

Bistable—An electronic circuit or device that has two operating states—such as a mechanical switch, indicator lamp or flip-flop.

Bit—A common abbreviation for binary digit.

Branch—A computer program procedure that transfers control from one instruction to another instruction elsewhere in the program.

Buffer—A circuit that isolates one circuit from another circuit.

Bug—An error. It can be a mistake in a computer program or a defect in the operation of a computer.

Bus—One or more electrical conductors that transmit power or binary data to the various sections of a computer.

Byte—A group of (usually) eight binary bits.

Calculator—A microprocessor-based instrument designed primarily for solving mathematical problems.

Card—A paper card containing punched slots that stores computer data or program instructions.

Card Reader—A computer input mechanism that reads out the information contained on a punched card.

Central Processing Unit (CPU)—The arithmetic-logic unit and control sections of a digital computer.

Character—Any letter, number or symbol that a digital computer can understand, store or process.

Chip—A thin slice of silicon up to a few tenths of an inch square with an integrated circuit containing from dozens to thousands of electronic parts on its surface.

Circuit—A collection of electronic parts and electrical conductors that performs some useful operation.

Clock—A circuit that produces a sequence of regularly spaced electrical pulses to synchronize the operation of the various circuits in a digital computer.

Code—A method of representing letters, numbers, symbols and data with binary numbers.

Combinational Logic—A collection of logic gates that responds to incoming information almost immediately and without regard to earlier events.

Compiler—A fairly advanced computer program that translates a high-level computer language such as BASIC into machine language.

Computer—An electronic device that processes discrete (digital) or approximate (analog) data. See Analog Computer and Digital Computer.

Control Section—The electronic nerve center of a digital computer, the circuits that decode incoming instructions and activate the various sections of the computer in perfect synchronization. Part of the Central Processing Unit (CPU).

Counter—A string of flip-flops that counts in binary.

CPU—See Central Processing Unit.

CRT—An acronym for **C**athode-**R**ay **T**ube. The video display tube used in television sets and many computer terminals.

Cycle—A specific time-interval during which a regular sequence of computer events take place.

Data—Numbers, facts, information, results, signals and almost anything else that can be fed into and processed by a computer.

Debug—The process of finding and fixing an error in a computer program or in the actual design of a computer. Often it takes more time to debug a program than to write it.

Decimal—A number system with the base ten.

Decision—A computer operation which compares two binary words or checks the status of a single bit or word and then takes a specified course of action.

Decoder—A combinational circuit that converts binary data into some other number system.

Decrement—To decrease the value of a number by some fixed value, often one.

Demultiplexer—A combinational circuit that applies the logic state of a single input to one of several outputs.

Digit—A character in a number system that represents a specific quantity.

Digital Computer—A computer that uses discrete signals to represent numerical quantities. Nearly all modern digital computers are two-state binary machines. They can be programmed to solve a wide variety of problems.

Disk Memory—See Magnetic Disk Memory.

Documentation—An important part of computer design and program development. The process of recording in organized format a detailed list of operational or programming considerations. Writing programs take time. Document them well!

Encoder—A combinational circuit that converts data from some other number system into binary.

Erase—To clear or remove data from a memory.

Execute—To comply with or act upon an instruction in a digital computer program.

Field—A particular category or grouping of data or instruction.

First Generation—Digital computers made with vacuum tubes.

Flip-Flop—The basic sequential logic circuit. A circuit which is always in one of two possible states.

Floppy Disk—See Magnetic Disk Memory.

Flow Chart—A diagram that shows the major steps or operations that take place in a computer program.

Gate—The simplest electronic logic circuit. A single gate may invert the logic state at its input or make a simple decision about the status of two or more inputs.

Glitch—An unwanted logic pulse produced when two interconnected logic circuits change states at slightly different times.

Hard Copy—A paper printout of computer results or data.

Hardware—The electronic circuits in a computer.

Hexadecimal—A number system with the base sixteen. "Hex" numbers are convenient for representing 4-bit binary nibbles.

Housekeeping—Operations that take place in a computer or a computer program that clear memories, check status registers, organize data and otherwise set things up in preparation for a data processing operation.

Illegal Operation—A program instruction that a computer cannot perform.

Increment—To increase the value of a number by some fixed value, often one.

Integrated Circuit—An electronic circuit formed on the surface of a tiny silicon chip.

Interpreter—A computer program that translates and then executes a computer program a step at a time.

Interrupt—Temporarily halting the operation of a digital computer to respond to (service) an external event.

K—A shorthand way of expressing the capacity of a computer memory. Corresponds to 2^{10} (1024). Therefore a 4K memory stores 4,096 bits.

Keyboard—A typewriter-like array of switches used to feed data into a digital computer manually.

Language—The symbols, phrases, characters and numbers used to communicate with a digital computer.

Line Printer—A printer that prints a complete line of type in one operation.

Logic Circuit—A gate or other circuit that responds to two-state signals.

Logical State—A condition which is either on or off, true or false, yes or no, etc. The two logical states are represented by the binary digits 0 and 1 in digital computers.

Loop—A sequence of computer instructions which is repeated one or more times until a desired result is achieved.

Machine Language—The binary language a computer understands.

Macroinstruction—A computer instruction composed of a sequence of micro-instructions.

Magnetic Core—A tiny ring of material that can store a single binary bit.

Magnetic Disk Memory—A memory system that stores and retrieves binary data on record-like metal or plastic disks coated with a magnetic material.

Magnetic Tape Memory—A memory system that stores and retrieves binary data on magnetic recording tape.

Memory—That part of a digital computer which stores data.

Microcomputer—A digital computer made by combining microprocessor with one or more memory circuits. Single chip microcomputers are also available.

Microprocessor—The complete central processing unit for a digital computer (arithmetic-logic unit, control section and some registers) on a single silicon chip.

Microinstruction—The most basic operation that takes place in a digital computer.

Mnemonic—A memory aid such as an abbreviation or acronym.

Multiplexer—A combinational circuit that applies the logic state of one of several inputs to a single output.

Negative Logic—A logic system where the binary bit 0 is represented by a high voltage level and the bit 1 by a low voltage level.

Nibble—Half a byte; a 4-bit word.

Nonvolatile Storage—A memory system that retains data without the need for electrical power.

Number—The representation of a quantity. In digital computers, numbers can represent data, characters, instructions, etc.

Object Program—A program written in or expressed in machine language.

Output Section—A printer, video display or other device that makes information processed by a computer available to an operator or an electronic device.

Paper Tape—A ribbon of paper that contains binary data in the form of perforations.

Paper Tape Reader—A computer input unit that reads data from a paper tape.

Parallel Processing—Operating on data a chunk of bits at a time.

Parity Bit—A binary bit added to a binary word to make the total number of 1s either even or odd.

Personal Computer—A microcomputer with a keyboard input designed for ease of use and maximum economy.

Positive Logic—A logic system where the binary bit 1 is represented by a high voltage level and the bit 0 by a low voltage level.

Printer—An output device that prints computer information on a strip of paper.

Processor—A digital computer.

Program—A list of instructions that tells a computer what to do and how to do it.

RAM—See Read/Write Memory.

Random Access Memory—A memory that offers equal access time to any storage location.

Read—To sense data from a magnetic tape, disk or punched card. Or to make information in a memory available to some other circuit.

Read-Only Memory—A memory that contians permanent data which can't be altered or erased. Usually designated ROM.

Read/Write Memory—A memory which contains information that can be erased and modified. Often designated RAM.

Register—A string of flip-flops that stores one word of binary data. A register is a temporary memory.

ROM—See Read-Only Memory.

Second Generation—Computers made with transistors.

Sequential Logic—A collection of logic gates that responds to incoming information only when a clock pulse is received. Sequential logic circuits use flip-flops so that each operation is affected by a previous operation.

Serial Processing—Operating on data a bit at a time.

Software—Paperwork such as programs and documentation associated with the operation of a computer.

Solid State—Electronic components or circuits made from solid materials such as silicon and germanium.

Source Program—A computer program written in a non-binary form such as assembly language or BASIC.

Storage Device—A computer memory.

Subroutine—A sequence of instructions in a computer program that is used more than once by the main program.

Synchronous—A computer operation that takes place under the control of a clock.

Teletypewriter—A typwriter-like device that can be used to feed data and programs into a computer and to print the output information from a computer on a strip of paper.

Terminal—A computer input/output device.

Third Generation—Computers made with integrated circuits.

Transistor—A solid-state electronic device which can be used as an amplifier or on-off switch. An integrated circuit is a complex network of transistors and other components on the surface of a small silicon chip.

Volatile Storage—A memory system that retains data only when electrical power is present.

Word—A string of binary bits used to represent a number, character or instruction in a digital computer. Computer words can be any length.

Write—To place information into a memory or register.